THE JOHN CRER
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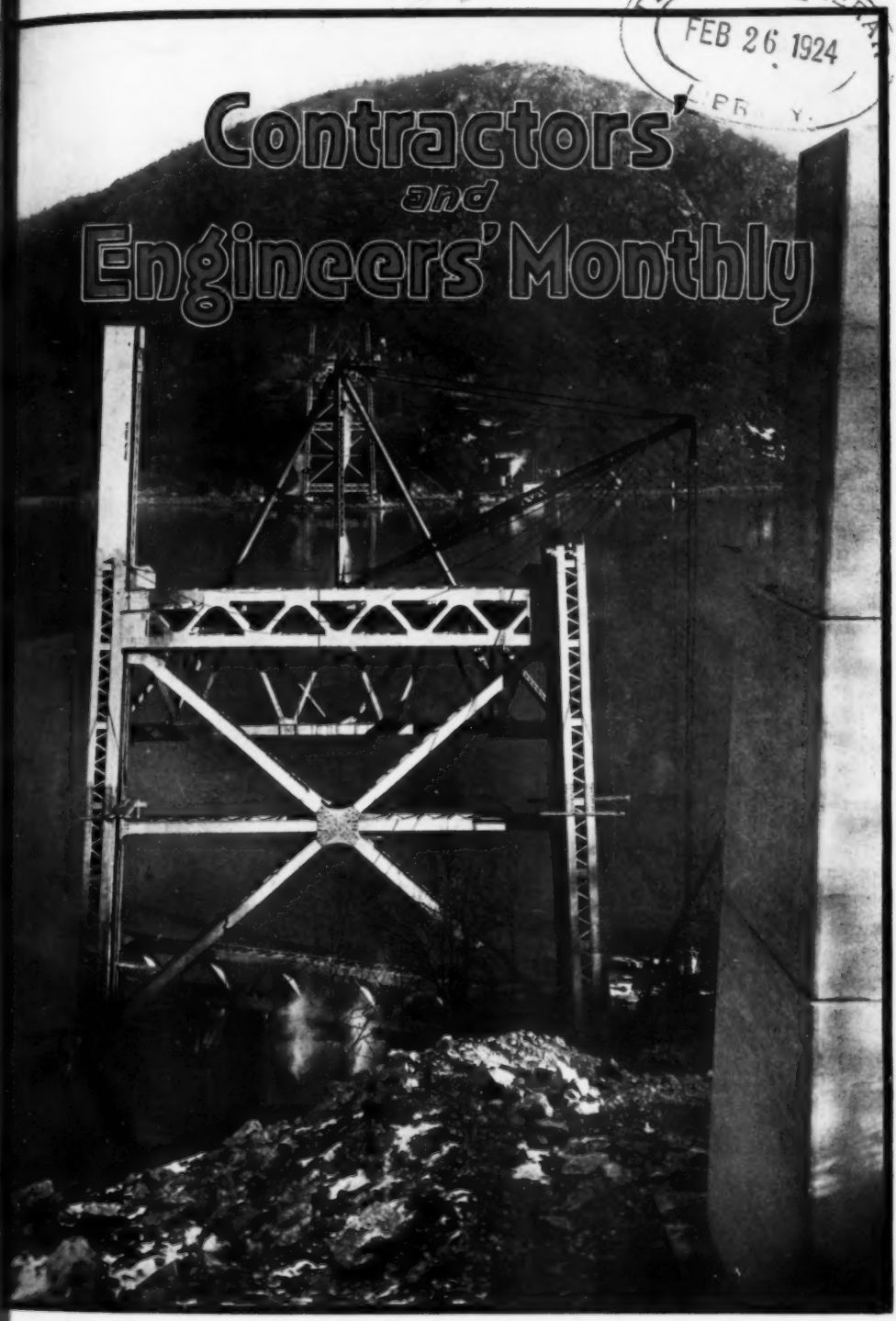
Contractors' and Engineers' Monthly



Construction View of New Bear Mountain Bridge Across the Hudson River

FEBRUARY, 1924 *See page 90 of this issue for description* 25 Cents $1 a Year

TRUSCON
WIRE MESH AND
CONTRACTION JOINTS
HIGHWAYS THAT STAND
WEAR AND TEAR
Concrete Roads with steel reinforcement stand up longer and withstand the terrific stress and strain of travel to a greater extent than any other construction.
Truscon Wire Mesh, with Truscon Dowel Contraction Joints, is the ideal reinforcement for concrete roads.
Write us for special information
TRUSCON STEEL COMPANY
Youngstown
Sales Offices in Principal Cities
OHIO

VOL. VIII. No. 2 CONTRACTORS' & ENGINEERS' MONTHLY FEBRUARY, 192
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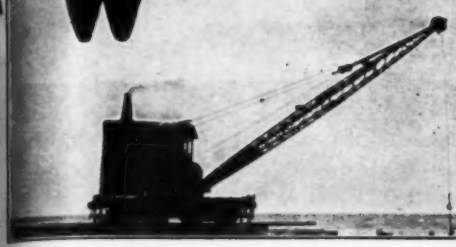
Where to Purchase



A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

ACETYLENE

Prest-O-Lite Co., Inc., New York.

ACETYLENE APPARATUS

Air Reduction Sales Co., New York.
Oxweld Acetylene Co., Newark, N. J.

ADDING MACHINES. (See Calculating Machines.)

AIR COMPRESSORS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., New York.
De Laval Steam Turbine Co., Trenton, N. J.
De La Vergne Machine Co., New York.
Domestic Engine & Pump Co., Shippensburg, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
General Electric Co., Schenectady, N. Y.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Nordberg Mfg. Co., Milwaukee, Wis.
Norwalk Iron Works Co., South Norwalk, Conn.
Schramm, Inc., West Chester, Pa.
Sullivan Mchy. Co., Chicago, Ill.
United Iron Works, Kansas City, Mo.
Westinghouse Trac. Brake Co., Wilmerding, Pa.
Worthington Pump & Mchy. Corp., New York.

ARC LAMPS

General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ARTESIAN WELL DRILLS AND PUMPS

Am. Well Works, Aurora, Ill.

ASBESTOS PRODUCTS

*Carey Co., Philip, Cincinnati, Ohio.
Darcoid Co., Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.
Mikesell Bros. Co., Wabash, Ind.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mountain Co., Chicago, Ill.

ASH HANDLING MACHINERY

*Haiss Mfg. Co., Geo., New York.
*International Motor Co., New York.
*Robins Conv. Belt Co., New York.
Bartlett & Snow Co., C. O., Cleveland O.
Bay City Dredge Wks., Bay City, Mich.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Byers Mach. Co., Ravenna, Ohio.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Green Eng. Co., East Chicago, Ind.
Guarantee Constr. Co., New York.
Jeffrey Mfg. Co., Columbus, Ohio.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Eng. Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Portable Machinery Co., Passaic, N. J.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

ASPHALT PRODUCERS

*Barber Asphalt Co., Philadelphia, Pa.
*Kentucky Rock Asphalt Co., Louisville, Ky.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
*Warren Bros. Co., Boston, Mass.
Atlantic Refining & Asphalt Corp., Phila., Pa
Barrett Co., New York.
Gulf Refining Co., Pittsburgh, Pa.
Headley Good Roads Co., Philadelphia, Pa.
New Orleans Refining Co., New Orleans, La.
Sinclair Ref. Co., Chicago, Ill.
Standard Oil Co. of Calif., San Francisco, Cal.
Standard Oil Co. of La., New Orleans, La.
Standard Oil Co. of N. J., Newark, N. J.
Standard Oil Co. of N. Y., New York.
U. S. Asphalt Refining Co., New York.

ASPHALT BLOCK

Hastings Pavement Co., New York.

ASPHALT CUTTERS

Dayton Pneumatic Tool Co., Dayton, Ohio.
Chicago Pneumatic Tool Co., New York
Ingersoll-Rand Co., New York.

ASPHALT KETTLES. (See Kettles for Asphalt and Tar Heating.)

ASPHALT PLANTS, TOOLS, ETC.

*Barber Asphalt Co., Philadelphia, Pa.
*Littleford Bros., Cincinnati, O.
*Warren Bros. Co., Boston, Mass.
Austin Machinery Corp'n, Toledo, O.
Bacon Co., Edw. R., San Francisco, Cal.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, Ohio.
Hetherington & Berner, Indianapolis, Ind.

ASPHALT ROLLERS. (See Road and Paving Rollers.)

ASPHALT SURFACE HEATERS

*Barber Asphalt Co., Philadelphia, Pa.
*Equitable Asphalt Maint. Co., Kansas City, Mo.
Hauck Mfg. Co., Brooklyn, N. Y.

BACKFILLERS

*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Koehring Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Byers Machine Co., Ravenna, Ohio.
Constr. Mchy. Co., Waterloo, Ia.
Oshkosh Mfg. Co., Oshkosh, Wis.
Parsons Co., Newton, Ia.
Weller Mfg. Co., Chicago, Ill.

BAR BENDERS AND CUTTERS

*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Concrete Steel Co., New York.
Electric Welding Co., Pittsburgh, Pa.
Hinman & Co., D. A., Sandwich, Ill.
McKenna Co., Cleveland, Ohio.

BAR CHAIRS, REINFORCING

*Truscon Steel Co., Youngstown, Ohio.
Concrete Steel Co., New York.
Universal Form Clamp Co., Chicago, Ill.

BARS, IRON AND STEEL

Aborn Steel Co., Inc., New York.
Ames & Co., W., Jersey City, N. J.
Bethlehem Steel Co., Bethlehem, Pa.

*Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

KOEHRING

REG. U. S. PAT. OFF.

Three Point Suspension

NO machine of the weight of a paving mixer can travel the inequalities of subgrade, pavement or road, without enduring terrific frame stresses unless these stresses are relieved by three point suspension as is the Heavy Duty Koehring paver.

Koehring extra heavy channel steel front axles are spaced well apart and riveted to spindle axle castings that slide between two heavy guides, giving a free fifth wheel oscillation.

This Koehring construction prevents the frame strains which otherwise throw moving parts out of alignment, and are the principal, if obscure cause of breakdown and delays.

Be sure of this — that Koehring Heavy Duty construction means an enduring construction that surpasses ordinary standards of how well a machine should be built.

Write for Koehring Paver Catalog—P.

CAPACITIES

Pavers—7, 10, 14, 21, 34 cubic feet mixed concrete. Steam, gasoline or electric power. Derrick arrangement—double derrick on 21E and auxiliary water tank on 21E and 32E if desired. Batch meter.

Construction Mixers—10, 14, 21, 28 cubic feet mixed concrete. Steam, gasoline or electric power. Rubber tires optional.

Dandie—4 and 7 cubic feet mixed concrete. Gasoline engine on 104S and 107S.

KOEHRING COMPANY

Pavers, Mixers, Cranes, Draglines, Gasoline Shovels

MILWAUKEE, WISCONSIN

Sales Offices, service warehouses in principal cities

Foreign Dept., Room 1370, 50 Church St., New York City.

Canada, Koehring Company of Canada, Limited, 105 Front Street, East, Toronto, Ontario.

Mexico, F. S. Lapum, Cinco De Mayo 21, Mexico, D. F.

Carbon Steel Co., Pittsburgh, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Franklin Steel Works, Franklin, Pa.
Gulf States Steel Co., Birmingham, Ala.
Hirsch Rolling Mill Co., St. Louis, Mo.
Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
Midvale Steel & Ordnance Co., Philadelphia, Pa.
Republic Iron & Steel Co., Youngstown, O.
St. Louis Screw Co., St. Louis, Mo.
Sweet's Steel Co., Williamsport, Pa.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.
United Alloy Steel Corp., Canton, Ohio.

BATCH BOXES

Lakewood Eng. Co., Cleveland, O.
Western Wheeled Scraper Co., Aurora, Ill.

BELTING, RUBBER

*Goodrich Rubber Co., B. F., Akron, O.
*Robins Conv. Belt Co., New York.
Allen Mfg. Co., W. D., Chicago, Ill.
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.
Fairbanks Co., The, New York.
Goodall Rubber Co., Inc., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, O.
Mulconroy Co., Inc., Philadelphia, Pa.
Republic Rubber Co., Youngstown, Ohio.
Salisbury & Co., Inc., W. H., Chicago, Ill.
Southern Rubber & Belt. Co., Houston, Tex.
Union Asbestos & Rubber Co., Chicago, Ill.
U. S. Rubber Co, New York.
Voorhees Rubber Mfg. Co., Jersey City, N. J.

BINS, STORAGE

*Atlas Eng. Co., Milwaukee, Wis.
*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Ransome Concrete Mach. Co., Dunnellen, N. J.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Fairfield Engineering Co., Lancaster, Ohio.
Green Engineering Co., E. Chicago, Ind.
Link-Belt Co., Chicago, Ill.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Weller Mfg. Co., Chicago, Ill.

BLAST HOLE DRILLING MACHINES. (See "Well Drilling and Blast Hole Machines")

BLASTING POWDER (See Explosives)

BLOCKS AND TACKLE

Boston & Lockport Block Co., East Boston, Mass
Broderick & Bascom Rope Co., St. Louis, Mo.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Topping Bros., New York.
Upson-Walton Co., Cleveland, Ohio.

BLOWERS, PRESSURE

American Blower Co., Detroit, Mich.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Spencer Turbine Co., Hartford, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass

BLOWPIPES

Oxweld Acetylene Co., Newark, N. J.

BLUE PRINT MACHINES

Dietzgen Co., Eugene, Chicago, Ill.
Keuffel & Esser Co., Hoboken, N. J.
Pease Co., C. F., Chicago, Ill.
Weber & Co., F., Philadelphia, Pa.
Wickes Bros., Saginaw, Mich.

BLUE PRINT AND TRACING PAPERS

Indianapolis Blue Print & S'ply Co., Ind'apolis.
Keuffel & Co., New York.

BOILERS

Abendroth & Root Mfg. Co., Newburgh, N. Y.
Ames Iron Works, Oswego, N. Y.
Babcock & Wilcox Co., New York.
Biggs Boiler Wks., Akron, Ohio.
Casey-Hedges Co., Chattanooga, Tenn.
Chandler & Taylor Co., Indianapolis, Ind.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Cole Mfg. Co., R. D., Newnan, Ga.
Erie City Iron Works, Erie, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Hartley Boiler Works, Montgomery, Ala.
Heine Boiler Co., St. Louis, Mo.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Ladd Co., Geo. T., Pittsburgh, Pa.
Leffel & Co., J., Springfield, O.
Lord & Burnham Co., Irvington, N. Y.
Murray Iron Works Co., Burlington, Ia.
New Bern Iron Wks. & Sup. Co., New Bern, N. C.
Petroleum Iron Works Co., Sharon, Pa.
Schofield Iron Works, Macon, Ga.
Traylor Engr. & Mfg. Co., Allentown, Pa.
Valk & Murdoch Co., Charleston, S. C.
Vogt Mchy. Co., Inc., Louisville, Ky.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

BOLTS, NUTS, NAILS, RIVETS, SPIKES

American Screw Co., Providence, R. I.
American Spike Co., New York.
Ames, W. & Co., Jersey City, N. J.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Bolt Co., Buffalo, N. Y.
Clark Bros. Bolt Co., Milldale, Conn.
Erie Bolt & Nut Co., Erie, Pa.
Foster Bolt & Nut Mfg. Co., Cleveland, Ohio.
Inland Steel Co., Chicago, Ill.
Lamson & Sessions Co., Cleveland, Ohio.
Maryland Bolt & Forge Co., Baltimore, Md.
Milton Mfg. Co., Milton, Pa.
Neely Nut & Bolt Co., Pittsburgh, Pa.
Oliver Iron & Steel Corp'n, Pittsburgh, Pa.
Pittsburgh Screw & Bolt Co., Pittsburgh, Pa.
Progressive Mfg. Co., Torrington, Conn.
Republic Iron & Steel Co., Youngstown, O.
Rhode Island Tool Co., Providence, R. I.
Russell, Bursdall & Ward Co., Port Chester, N. Y.
St. Louis Screw Co., St. Louis, Mo.
Scranton Bolt & Nut Co., Scranton, Pa.
Star Exp. Bolt Co., New York.
Sweet's Steel Co., Williamsport, Pa.

BRACES, TRENCH

Channon Mfg. Co., Jas. H., Chicago, Ill.
Duff Mfg. Co., Pittsburgh, Pa.
Kalamazoo Fdry. & Mach. Co., Kalamazoo, Mich.
Waldo Bros. & Bond Co., Boston, Mass.

BRASS GOODS

*Union Water Meter Co., Worcester, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Hays Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
United Brass Mfg. Co., Cleveland, O.

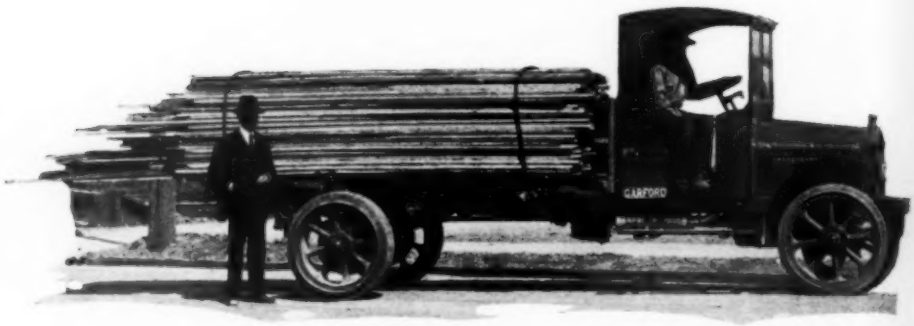
BREAKERS, CONCRETE

Buckeye Traction Ditcher Co., Findlay, O.
Chicago Pneumatic Tool Co., New York.
Ingersoll-Rand Co., New York City

BRICK, PAVING (See Paving Brick)

BRIDGES AND BUILDINGS, STEEL

*Blaw-Knox Co., Pittsburgh, Pa.
*Frederick Snare Corporation, New York.
American Bridge Co., New York.
Bellefontaine Bridge & Steel Co., Bellefontaine, O
Belmont Iron Works, Philadelphia, Pa.
Berlin Constr. Co., Berlin, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Boston Bridge Works, Boston, Mass.
Central States Bridge Co., Indianapolis, Ind.
Champion Bridge Co., Wilmington, O.
Chesapeake Iron Works, Baltimore, Md.
Chicago Bridge & Iron Works, Chicago, Ill.
Clinton Bridge Wks., Clinton, Iowa.
Eastern Bridge & Struc. Co., Worcester, Mass.
Flour City Orn. Iron Co., Minneapolis, Minn.
Fort Pitt Bridge Works, Pittsburgh, Pa.
Ingalls Iron Works Co., Birmingham, Ala.
Inter. Steel & Iron Co., Evansville, Ind.
Lewis-Hall Iron Wks., Detroit, Mich.
Louisville Bridge & Iron Co., Louisville, Ky.
McClintic Marshall Co., Pittsburgh, Pa.
Milwaukee Bridge Co., Milwaukee, Wis.



Deliver Heavy Awkward Loads Of Lumber Quickly

The Garford shown above is one of two operated by the Heywood Lumber Company in delivering lumber about Alameda County, California.

It is equipped with a 4-roller lumber body with four binders and head board. Loading is simple, and varying lengths which are awkward to handle are quickly and easily transported. Similar equipment has proved the satisfactory, economical means of lumber distribution for many concerns. Garfords have plenty of power for unusual ordeals, and the steady, dependablility of operation to keep the truck in constant service month after month, with minimum upkeep cost.

▽ ▽

Garford Engineers can recommend and provide units designed and equipped for your specific haulage conditions. Periodical inspections by Garford Service Inspectors insure long, satisfactory performance on the low-cost ton-mile basis. Write for particulars.

The Garford Motor Truck Company, Lima, O.

Manufacturers of Motor Trucks 1 to 7½ Tons

GARFORD

DEPENDABLE TRANSPORTATION

Minn. Steel & Mchy. Co., Minneapolis, Minn
Missouri Vy. Bdge. & Iron Co., Leavenworth, Kan.
Morava Constr. Co., Chicago, Ill.
Mt. Vernon Bridge Co., Mt. Vernon, Ohio.
Penn. Bridge Co., Beaver Falls, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Richmond Struc. Steel Co., Richmond, Va.
Riverside Bridge Co., Martins Ferry, O.
Virginia Bridge & Iron Co., Roanoke, Va.
Wisc. Bridge & Iron Co., North Milwaukee, Wis

BRONZE TABLETS

Flour City Orn. Iron Co., Minneapolis, Minn.
Imperial Brass Mfg. Co., Chicago, Ill.
Mott Iron Wks., J. L., New York

BROOMS (See Street Sweeping Brooms)

BUCKETS, AUTOMATIC DUMPING

*Littleford Bros., Cincinnati, O
Lakewood Engineering Co., Cleveland, O.
Stuebner Iron Works, G. L., Long Island City,

BUCKETS, CLAM SHELL

*Blaw-Knox Co., Pittsburgh, Pa.
*Haiss Mfg. Co., Geo., New York.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Byers Mach. Co., J. F., Ravenna, O.
Coleman Co., F. A., Cleveland, O.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Engineering Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Owen Bucket Co., Cleveland, Ohio
Williams Co., G. H., Erie, Pa.

BUCKETS, CONCRETE

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Rochester Can Co., Rochester, N. Y.
Smith Co., T. L., Milwaukee, Wis.
Union Iron Works, Inc., Hoboken, N. J.
Weller Mfg. Co., Chicago, Ill.

BUCKETS, DRAGLINE

*Sauerman Bros., Chicago, Ill.
Austin Machinery Corp'n, Toledo, O.
Brown Hoisting Mach. Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Monighan Machine Co., Chicago, Ill.

BUCKETS, DREDGING AND EXCAVATING

*Blaw-Knox Co., Pittsburgh, Pa.
*Haiss Mfg. Co., Inc., Geo., New York.
Austin Machinery Corp'n, Toledo, O.
Brown Hoisting Mach. Co., Cleveland, O.
Browning Co., Cleveland, O.
Hayward Co., New York.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Eng. Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Owen Bucket Co., Cleveland, Ohio.
Williams Co., G. H., Erie, Pa.

BUCKETS, ORANGE PEEL

Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
McMyler Interstate Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Vulcan Iron Works, Jersey City, N. J.

BUILDERS' HARDWARE

Corbin, P. & F., New Britain, Conn.
Reading Hardware Co., Reading, Pa.
Russell & Erwin Mfg. Co., New Britain, Conn.
Sargent & Co., New Haven, Conn.
Stanley Works, New Britain, Conn.
Yale & Towne Mfg. Co., New York.

BUILDINGS, STEEL (See Bridges and Buildings)

BUNKS AND COTS

Fort Pitt Bedding Co., Pittsburgh, Pa.
Haggard & Marcusson Co., Chicago, Ill.
Southern Rome Co., Baltimore, Md.

CABLES (See Wire and Cables)

CABLEWAYS

*Sauerman Bros., Chicago, Ill.
*Street Bros. Mach. Wks., Chattanooga, Tenn.
Broderick & Bascom Rope Co., St. Louis, Mo.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Manufacturing Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Roebling Sons Co., J. A., Trenton, N. J.
Waterbury Co., New York.

CAISSONS

American Bridge Co., New York.
Foundation Co., New York.
Bethlehem Steel Co., Bethlehem, Pa.
O'Rourke Eng. Constr. Co., New York.
Petroleum Iron Works Co., Sharon, Pa.

CALCIUM CHLORIDE FOR ROADS

*Dow Chemical Co., Midland, Mich.
*Semet-Solvay Co., Syracuse, N. Y.
Carbondale Calcium Co., Carbondale, Pa.

CALCULATING MACHINES

Burroughs Adding Machine Co., Detroit, Mich
Dalton Adding Mach. Co., Cincinnati, O.
Felt & Tarrant Mfg. Co., Chicago, Ill.
Marchant Calc. Machine Co., Oakland, Cal.
Monroe Calculating Machine Co., Orange, N. J

CANS FOR GARBAGE AND STREET REFUSE

*Rochester Can Co., Rochester, N. Y.
American Can Co., New York.
Butler Mfg. Co., Minneapolis, Minn.
Economy Baler Co., Ann Arbor, Mich.
Safety Sanitary Rubbish Box Co., Columbus, O
Solar-Sturges Mfg. Co., Chicago, Ill.
Steel Basket Co., Cedar Rapids, Iowa.

CARS, INDUSTRIAL V. DUMPING

*Insley Mfg. Co., Indianapolis, Ind.
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Austin Machinery Corp'n, Toledo, O.
Atlas Car & Mfg. Co., Cleveland, O.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constr. Co., New York.
Hunt Co., C. W., W. New Brighton, N. Y.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Light Ry. Equipment Co., Philadelphia, Pa.
Oliver Mfg. Co., W. J., Knoxville, Tenn.
Stuebner Iron Works, G. L., L. I. City, N. Y.
United Iron Works, Kansas City, Mo.
Weller Mfg. Co., Chicago, Ill.
Whiting Corp'n, Harvey, Ill.

CARTS, CONCRETE

*Insley Mfg. Co., Indianapolis, Ind.
*Littleford Bros., Cincinnati, O.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Akron Barrow Co., Cleveland, Ohio.
Etnyre & Co., E. D., Oregon, Ill.
Gray Iron Fdry. Co., Reading, Pa.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Lee Trailer & Body Co., Chicago, Ill.
Smith Co., T. L., Milwaukee, Wis.
Sterling Wheelbarrow Co., Milwaukee, Wis.
Toledo Wheelbarrow Co., Toledo, Ohio.

CAST IRON PIPE (See Pipe, Cast Iron)

CASTINGS, STREET AND SEWER

*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.

30 Fords, fitted with Self-Dumper Bodies are delivering materials to this mixer. The haul is over 7 miles of bad road, near Richmond, Va.

WOOD SELF-DUMPER

Low In First Cost and In Maintenance

The rapid rise in favor of the **Wood Self-Dumper** with road builders is due to its low initial cost and its freedom from up-keep cost.

Sturdy and dependable, this all-steel body enables the Ford to do a bigger day's work.

It is instantaneous in action—no hoist is required—it is controlled entirely from the driver's seat.

Any Ford dealer can supply you; or we shall be glad to send special descriptive folder.

Complete Ready to Install

$140

F.O.B. Detroit, tax extra.

WOOD HYDRAULIC HOIST & BODY COMPANY

WORLD'S LARGEST MAKERS OF HYDRAULIC HOISTS AND STEEL BODIES EXCLUSIVELY

7938 RIOPELLE STREET DETROIT, MICHIGAN

Canton Foundry & Machine Co., Canton, O.
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, J. B., Chicago, Ill.
Dee Co., W. E., Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Foundry Mfg. Co., St. Albans, Vt.
Klauer Mfg. Co., Dubuque, Iowa.
Madison Foundry Co., Cleveland, O.
Pechstein Iron Works, Keokuk, Ia.
Sessions Foundry Co., Bristol, Conn.
South Bend Foundry Co., South Bend, Ind.

CATCH BASINS (See Castings, Street and Sewer)

CATCH BASIN CLEANING APPARATUS
*International Motor Co., New York.
Elgin Sales Corp., New York.

CAULKING MACHINERY AND TOOLS
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Mueller Mfg. Co., H., Decatur, Ill.

CEILINGS, METAL
Berger Mfg. Co., Canton, O.
Canton Art Metal Co., Canton, O.
Newport Rolling Mill Co., Newport, Ky.
Klauer Mfg. Co., Dubuque, Iowa.
Mesker & Co., Geo. L., Evansville, Ind.
Milwaukee Corrugating Co., Milwaukee, Wis.
Wheeling Corrugating Co., Wheeling, W. Va.

CEMENT
*Pennsylvania Cement Co., New York
Ætna Portland Cement Co., Detroit, Mich.
Allentown Portland Cement Co., Allentown, Pa.
Alpha Portland Cement Co., Easton, Pa.
Ash Grove Lime and Portland Cement Co., Kansas City, Mo.
Atlas Portland Cement Co., New York.
Bath Portland Cement Co., Philadelphia, Pa.
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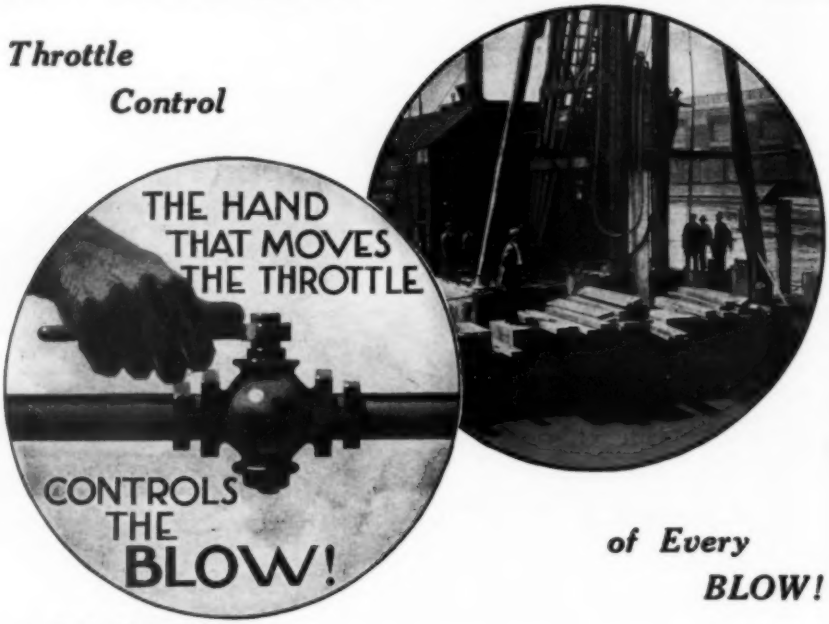

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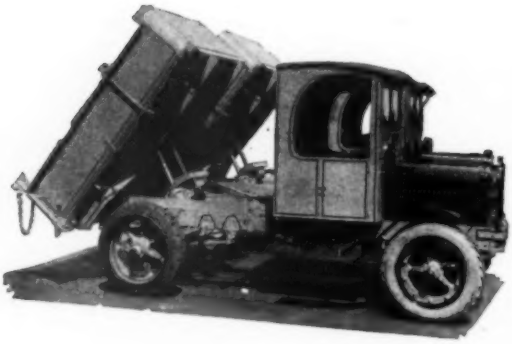

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Due to unfortunate conditions over which we had no control, we were unable to exhibit

THE LITTLEFORD PULLAR ASPHALT PRODUCING PLANT

at the Road Show. The plant arrived too late to permit its being placed in the Coliseum.

So to the many hundreds who eagerly anticipated seeing The "PULLAR" for the first time, we offer our sincere apologies.

To those, however, who were disappointed and to all other interested persons, we will be glad to receive requests for detailed information concerning the most remarkable contribution to Road Construction and Maintenance Equipment since the invention of the Portable paving plant.

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*Ransome Concrete Mchy. Co., Dunellen, N. J.
Archer Iron Works, Chicago, Ill.
Lakewood Engineering Co., Cleveland, O.

DITCHING MACHINES (See Excavators, Ditch and Trench)

DIVIDING PLATES (ROAD)

*Godwin Co., W. S., Baltimore, Md.

DOORS, HOLLOW METAL

Dahlstrom Metallic Door Corp., Jamestown, N. Y.
United Metal Products Co., Canton, Ohio

DOORS, METAL (KALAMEIN)

Friedrich Co., E. H., Holyoke, Mass.
Lawton-Stephens Co., Brooklyn, N. Y.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Riester & Thesmacher Co., Cleveland, Ohio.
Sykes Co., Chicago, Ill.
Thorp Fireproof Door Co., Minneapolis, Minn.

DOORS AND SHUTTERS, STEEL ROLLING

Cornell Iron Works, New York.
Kinnear Mfg. Co., Columbus, O.
Variety Mfg. Co., Chicago, Ill.
Wilson Corp., J. G., New York.

DRAFTING MACHINES

Universal Drafting Machine Co., Cleveland, O.

DREDGES

*Osgood Co., The, Marion, O.
*Street Bros. Mach. Wks., Chattanooga, Tenn.
American Steel Dredge Co., Fort Wayne, Ind.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Machine Corp'n., Baltimore, Md.
Erie Steam Shovel Co., Erie, Pa.
Hayward Co., New York.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Michigan Dredge Co., Bay City, Mich.
Stockton Iron Works, Stockton, Cal.
Superior Iron Works, Superior, Wis.
Vulcan Iron Works, Jersey City, N. J.

DREDGES, DIPPER

Osgood Co., Marion, O.
American Steel Dredge Co., Fort Wayne, Ind.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.

DREDGES, HYDRAULIC

Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore, Md.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.

DREDGING PUMPS AND ACCESSORIES

Erie Pump & Engine Wks., Medina, N. Y.

DRILLS, AIR

*Dallett Co., Thos. H., Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, CORE

*McKiernan-Terry Drill Co., New York.
Dobbins Core Drill Co., Inc., New York.
Ingersoll-Rand Co., New York.
Standard Diamond Drill Co., Chicago, Ill.
Sullivan Mach'y Co., Chicago, Ill.

DRILLS, HAMMERS (PNEUMATIC)

*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Nail. Elec. Mfg. Co., Pittsburgh, Pa.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, ROCK

*Dallett Co., Thos. H., Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
*Wood Drill Works, Paterson, N. J.
Chicago Pneumatic Tool Co., New York.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Natl. Elec. Mfg. Co., Pittsburgh, Pa.
Sullivan Machinery Co., Chicago, Ill.

DRILLS FOR WELLS AND BLAST HOLES (See Well Drilling Machinery)

DRUMS, HOLDING

*Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Monighan Machine Co., Chicago, Ill.

DRYERS, ASPHALT AND CEMENT

Allis-Chalmers Co., Milwaukee, Wis.

These Engineers Find Fordized Haulage Most Economical

The R. L. Steed Eng. Co., erecting engineers, specializing in the installation and overhauling of power plants in Detroit, use Ford Trucks and Fordson Tractors exclusively for hauling heavy machinery and supplies.

A Ford One-Ton Truck with a big semi-trailer having a 30-ton axle and wheel capacity is used for heavy duty work. Loads ranging from 5 to 22½ tons are carried at an average cost per ton-mile of less than 33 cents. This exceptionally low cost enables this company to give customers a much lower hourly rate than the prevailing charge for larger trucks. This truck and trailer are shown above with a 9-ton planing mill, a typical load.

This company is completely Fordized. Superintendents and foremen use a Ford Sedan for rapid transit from one job to another; a fast Ford Model T "pick-up" saves much time delivering tools and supplies; a fleet of three Ford one-ton trucks, equipped with sturdy trailers, and a Fordson Tractor comprise their heavy haulage equipment.

Eight years of satisfactory experience in the use of these dependable units has proved to this company that to Fordize is to economize.

Any Authorized Ford Dealer will be glad to help you work out your haulage problems.

Ford

CARS · TRUCKS · TRACTORS

American Blower Co., Detroit, Mich.
American Process Co., New York.
Atlas Dryer Co., Cleveland, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, O.
Ruggles-Coles Eng. Co., New York.
Variety Iron & Steel Works, Cleveland, O.

DRYERS, SAND AND GRAVEL

*Littleford Bros., Cincinnati, Ohio.

DUMP BODIES FOR MOTOR TRUCKS

*Heil Company, Milwaukee, Wis.
*Insley Mfg. Co., Indianapolis, Ind.
*International Motor Co., New York.
*Littleford Bros., Cincinnati, O.
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
(Horizontal Hydraulic Hoist Co., Detroit, Mich.)
Archer Iron Works, Chicago, Ill.
Auto Truck Steel Body Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Columbia Wagon & Body Co., Columbia, Pa.
Griscom-Russell Co., New York
Jennings Automatic Dump Body, Roanoke, Va.
Lee Trailer & Body Co., Chicago, Ill
Pechstein Iron Works, Keokuk, Iowa.
Simplex Mfg. Co., Conneautville, Pa.
Van Dorn Iron Wks., Cleveland, Ohio.

DUMP CARTS AND WAGONS, HORSE DRAWN

*Austin Western Road Mchy. Co., Chicago, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Acme Road Machinery Co., Frankfort, N. Y.
Acme Wagon Co., Emigsville, Pa.
Austin Mfg. Co., Chicago, Ill.
Columbia Wagon & Body Co., Columbia, Pa.
Eagle Wagon Works, Auburn, N. Y.
Holzbog & Bro., Geo. H., Jeffersonville, Ind.
Stroud & Co., Omaha, Nebr.
Tiffin Wagon Co., Tiffin, Ohio.
Watson Products Corp., Canastota, N. Y.
Western Wheeled Scraper Co., Aurora, Ill.

DUST LAYING (CALCIUM CHLORIDE)

*Dow Chemical Co., Midland, Mich.
*Semet-Solvay Co., Syracuse, N. Y.
Carbondale Calcium Co., Carbondale, Pa.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE

Pacific Flush Tank Co., Chicago, Ill.
Yeomans Bros. Co., Chicago, Ill.

ELECTRIC GENERATORS AND MOTORS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Ideal Elec. & Mfg. Co., Mansfield, O.
Lincoln Electric Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Triumph Electric Co., Cincinnati, O
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC LAMPS

General Electric Co., Schenectady, N. Y.
Westinghouse Lamp Co., New York.

ELECTRIC LIGHTING PLANTS

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Universal Motor Co., Oshkosh, Wis.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Western Electric Co., New York.

ELECTRIC SUPPLIES, METERS, ETC.

Bissell Co., F., Toledo, Ohio.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC TRANSFORMERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC WIRES AND CABLES. (See "Wire and Cable")

ELEVATORS, BUCKET

*Atlas Eng. Co., Milwaukee, Wis.
*Austin Western Road Machy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, Ohio.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

ELEVATORS, PASSENGER, FREIGHT, ETC.

Albro-Clem Elevator Co., Philadelphia, Pa.
Amer. Elevator & Mach. Co., Louisville, Ky.
Bay State Elevator Co., Springfield, Mass.
Haughton Elev. & Mach. Co., Toledo, Ohio.
Kaestner & Hecht Co., Chicago, Ill.
Llewellyn Iron Works, Los Angeles, Cal.
Montgomery Elevator Co., Moline, Ill.
Otis Elevator Co., New York.
Ridgeway & Son Co., C., Coatesville, Pa.
See Elec. Elevator Co., A. B., New York.
Speidel, J. G., Reading, Pa.
Warner Elevator Mfg. Co., Cincinnati, O.
Warsaw Elevator Co., Warsaw, N. Y.

ENGINES, GAS AND GASOLINE

*Climax Engineering Co., Clinton, Ia.
*Hercules Corpn., Evansville, Ind.
*Holt Mfg. Co., Peoria, Ill.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Buda Co., Harvey, Ill.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
Domestic Engine & Pump Co., Shippensburg, Pa.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, Ohio.
Fuller & Johnson Mfg. Co., Madison, Wis.
Gade Bros. Mfg. Co., Iowa Falls, Iowa.
Nelson Bros. Co., Saginaw, Mich.
"New-Way" Motor Co., Lansing, Mich.
Novo Engine Co., Lansing, Mich.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.
Wellman-Seaver-Morgan Co., Cleveland, O.
Worthington Pump & Mchy. Corp., New York

ENGINES, OIL

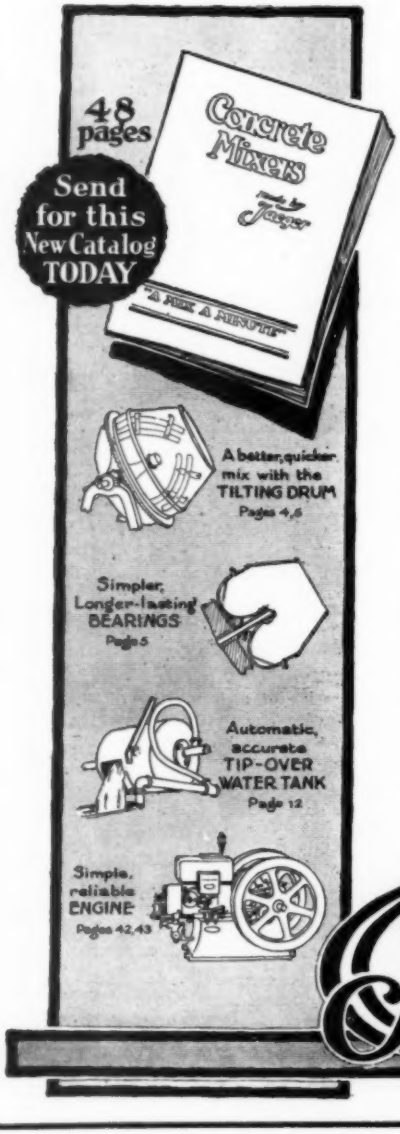
DIESEL

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
Dodge Sales & Eng. Co., Mishawaka, Ind.
Fulton Iron Works Co., St. Louis, Mo.
Hadfield-Penfield Steel Co., Bucyrus, Ohio.
McIntosh & Seymour Corp., Auburn, N. Y.
Nordberg Mfg. Co., Milwaukee, Wis.
Western Machy. Co., Los Angeles, Cal.

SEMI-DIESEL

Anderson Fdry. & Mach. Co., Anderson, Ind
Bessemer Gas Eng. Co., Grove City, Pa.
Buckeye Machinery Co., Lima, O.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York
De La Vergne Machine Co., New York
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, O.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Muncie Oil Eng. Co., Muncie, Ind.
Nordberg Mfg. Co., Milwaukee, Wis.
St. Mary's Oil Eng. Co., St. Charles, Mo.
Stover Mfg. & Engine Co., Freeport, Ill.
Taylor Machine Co., Cleveland, O.
Weber Engine Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., New York.

Facts You Should Know Before Buying Any Concrete Mixer



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It is infringement to make, use or sell a patented invention without authority under the patent. Our patents have been sustained by the United States Courts in six different instances. Purchasers of our Mixers are protected.

Jaeger
"A MIX A MINUTE"

ENGINES, PUMPING

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hooven, Owen, Rentschler Co., Hamilton, O.
Murray Iron Wks., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Worthington Pump & Mchy. Corp., New York.

ENGINES, STEAM

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dake Engine Co., Grand Haven, Mich.
Erie-Ball Engine Co., Pittsburgh, Pa.
Erie Pump & Engine Co., Medina, N. Y.
Filer-Stowell Co., Milwaukee, Wis.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Leffel Co., J., Springfield, O.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Vilter Mfg. Co., Milwaukee, Wis.

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

EXCAVATORS, CABLEWAY

Bucyrus Co., South Milwaukee, Wis.
Lidgerwood Mfg. Co., New York.

EXCAVATORS, DITCH AND TRENCH

*Insley Mfg. Co., Indianapolis, Ind.
*Keystone Driller Co., Beaver Falls, Pa.
*Osgood Co., The, Marion, O.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Byers Machine Co., Ravenna, Ohio.
Ball Engine Co., Erie, Pa.
Buckeye Traction Ditcher Co., Findlay, Ohio.
Bucyrus Co., South Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., The, New York City.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Parsons Co., Newton, Ia.
Topping Machy. Co., Chas. T., Dayton, O.

EXCAVATORS, DRAG-LINE

*Bay City Dredge Works, Bay City, Mich.
*Osgood Co., The, Marion, O.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Sauerman Bros., Chicago, Ill.
Austin Machinery Corp'n, Toledo, O.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Gade Excavator Works, C. L., Iowa Falls, Iowa
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Parsons Co., Newton, Ia.
Smith Co., T. L., Milwaukee, Wis.

EXPANDED METAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consolidated Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Northwestern Expanded Metal Co., Chicago, Ill.
Youngstown Pressed Steel, Co., Warren, O.

EXPANSION JOINT MATERIAL

*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
*Waring-Underwood Co., Philadelphia, Pa.
Asphalt Products Co., Contesville, Pa.
Barrett Co., New York.
Servicised Products Co., Chicago, Ill.

EXPLOSIVES

Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., E.I., Wilmington, Del.
Giant Powder Co., Cons., San Francisco, Cal.
Hercules Powder Co., Wilmington, Del.

FENCING

Adrian Wire Fence Co., Adrian, Mich.
American Steel & Wire Co., Chicago, Ill.
Anchor Post Iron Works, New York.
Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Cleveland, O.
Indiana Steel & Wire Co., Muncie, Ind.
Nitselman Bros., Muncie, Ind.
Michigan Wire Fence Co., Adrian, Mich.
Page Steel & Wire Co., Bridgeport, Conn.
Pittsburgh Steel Co., Pittsburgh, Pa.
Stewart Iron Works Co., Cincinnati, Ohio.
Texas Cyclone Fence Co., Fort Worth, Tex.
Wickwire Spencer Steel Corp., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

FILING EQUIPMENT, STEEL

Art Metal Constr. Co., Jamestown, N. Y.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works, Cleveland, O.

FILTERS, OIL

Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER

American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewel Filtr. Co., Nutley, N. J.
Norwood Engineering Co., Florence, Mass.
Roberts Filter Co., Darby, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.

FIRE ALARM SYSTEMS

Gamewell Fire Alarm Tel. Co., Newton Upper Falls, Mass.

FIRE ALARM SIRENS

Erick Elec. Siren Co., St. Paul, Minn.
Federal Sign System, Chicago, Ill.
Hendrie & Bolthoff Mfg. & Sup. Co., Denver, Col.
Interstate Machine Prod. Co., Rochester, N. Y.
Sireno Co., Stapleton, N. Y.
Union Water Meter Co., Worcester, Mass.

FIRE APPARATUS, MOTOR

*International Motor Co., New York.
Ahrens-Fox Fire Engine Co., Cincinnati, O.
American-La France Fire Eng. Co., Elmira, N. Y.
Brockway Motor Fire App. Co., Cortlandt, N. Y.
Northern Fire Apparatus Co., Minneapolis, Minn.
Foamite-Childs Corp., Utica, N. Y.
Pirsch & Sons Co., Peter, Kenosha, Wis.
Prospect Mfg. Co., Prospect, O.
Seagrave Co., Columbus, O.
Stutz Fire Engine Co., Indianapolis, Ind.
Waterous Fire Engine Co., St. Paul, Minn.

FIRE EXTINGUISHERS, CHEMICAL

American-La France Fire Eng. Co., Elmira, N. Y.
Cross Mfg. Co., C. J., Inc., New York.
Foamite-Childs Co., Utica N. Y.
Pyrene Mfg. Co., Newark, N. J.

FIRE HOSE. (See Hose, Fire)

FIREPROOF BUILDING MATERIAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Delaware Clay Products Co., Pittsburgh, Pa.
Detroit Steel Prod. Co., Detroit, Mich.
General Fireproofing Co., Youngstown, O.
Keasbey & Mattison Co., Ambler, Pa.
Kinnear Mfg. Co., Columbus, O.
National Fireproofing Co., Pittsburgh, Pa.
United States Gypsum Co., Chicago, Ill.
Youngstown Pressed Steel, Co., Warren, O.

FIRST AID EQUIPMENT

American-La France Fire Eng. Co., Elmira, N. Y.

Buy *Results* not simply *Machinery*

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RESULTS = Results = RESULTS

The whole highway industry is fighting for ***better, quicker,*** and more ***economical RESULTS.***

Some machines are bought on price—and the purchaser saves ***ONCE***—and that's all.

Stockland Quicklift Graders are bought on RESULTS—and the purchaser saves day after day, and week after week, and year after year, all during the long life of the machine.

Stockland Quicklift Graders are not built to compete in price. They ARE built to ***successfully compete in results.***

Almost every grader made is ***cheaper*** than the Stockland Quicklift—if you are buying a machine.

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Stockland
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Export Office—738-A Knickerbocker Building, 152 W. 42nd Street, New York City. Cable Address—Oparo, New York

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1. The Quicklift raises the blade assembly ***instantly.***

2. The Cutting Blade cuts ***down*** and ***under*** the earth—***uniform*** work on deep or shallow cuts.

3. The Curved Moldboard ***rolls*** the earth—greater earth moving capacity with less power.

4. The Built-in Steering Device absolutely controls the front wheels even on the sharpest turns.

5. All-Steel Gears give long life and freedom from repairs—all parts built of quality material.

6. One-piece hot-riveted frame gives strength combined with flexibility—longer life; fewer repairs.

7. Operator's control makes for easy operation—every needed adjustment centered at operator's platform.

8. Stockland Service—less than 12 hours from anywhere in the country.

FLEXIBLE JOINTS
*Central Foundry Co., New York.
*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
Coldwell-Wilcox Co., Newburgh, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
United Lead Company, New York.

FLOORING, COMPOSITION
*Barber Asphalt Co., Philadelphia, Pa.
Am. Mason Safety Tread Co., Lowell, Mass.
Barrett Co., New York.
Johns-Manville Co., H. W., New York.
Marine Decking & Supply Co., Phila., Pa.
Muller, Franklyn R., & Co., Waukegan, Ill.

FLOORS, WOOD BLOCK
Barrett Co., New York.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Toledo, O.
Republic Creosoting Co., Indianapolis, Ind.
Servicised Products Co., Chicago, Ill.
Sou. Wood Preserving Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

FLUSH TANKS
Pacific Flush Tank Co., Chicago, Ill.

FLUSHERS, STREET. (See Street Flushers and Sprinklers.)

FORGES
Buffalo Forge Co., Buffalo, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.

FORM CLAMPS
*Insley Mfg. Co., Indianapolis, Ind.
Marion Malleable Iron Works, Marion, Ind
Universal Form Clamp Co., Chicago, Ill.

FORMS, CONCRETE
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Philadelphia, Pa.
*Truscon Steel Co., Youngstown, O.
Concrete Form Co., Inc., Syracuse, N. Y.
Hetsel Steel Form & Iron Co., The, Warren, O.
Lakewood Eng. Co., Cleveland, Ohio.
Metal Forms Corp., Milwaukee, Wis.

FOUNTAINS, DRINKING
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, Jas. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Mott Iron Wks., J. L., New York.
Murdock Mfg. & Supply Co., Cincinnati, Ohio.
Puro San. Dr. Ftn. Co., Haydenville, Mass.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
Stewart Iron Works Co., Cincinnati, O.
Taylor Co., Halsey W., Warren, O.
Twentieth Century Brass Wks., Belleville, Ill.

FURNITURE AND FILES, STEEL
Art Metal Constn. Co., Jamestown, N. Y.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works Co., Cleveland, O.

GARBAGE CANS. (See Cans)

GARBAGE DISPOSAL
Balmer Corp., New York.
Bartlett, C. O. & Snow Co., Cleveland, O.
Decarie Incinerator Co., Minneapolis, Minn.
Jones & Very, New York
Morse-Boulger Destructor Co., New York.
Nye Odorless Crematory Co., Macon, Ga.

GARAGE TRUCKS AND BODIES
*Heil Co., Milwaukee, Wis.
Holsbog & Bro., Geo. H., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago, Ill.
Tiffin Wagon Co., Tiffin, O.
Watson Products Corp., Canastota, N. Y.

GAS ENGINES. (See Engines, Gas and Gasoline.)

GAS METERS. (See Meters, Gas)

GAS PRODUCERS
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Wood & Co., R. D., Florence, N. J.

GASOLINE STORAGE TANKS
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Bigga Boiler Works, Akron, Ohio.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Byers Machine Co., Ravenna, Ohio.
Chicago Bridge & Iron Works, Chicago, Ill.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
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Bristol Co., Waterbury, Conn.
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Marsh & Co., Jas. P., Chicago, Ill.
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U. S. Gauge Co., New York

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Lunkenheimer Co., Cincinnati, O.
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*Shunk Mfg. Co., Bucyrus, Ohio.

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HAMMERS, STEAM, PILE. (See Pile Hammers, Steam)

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Mead-Morrison Mfg. Co., E. Boston, Mass.
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National Hoisting Engine Co., Harrison, N. J.
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Delaware Clay Products Co., Pittsburgh, Pa.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Medal Paving Brick Co., Cleveland, Ohio.
Metropolitan Paving Brick Co., Canton, Ohio.
National Fireproofing Co., Pittsburgh, Pa.

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*Littleford Bros., Cincinnati, O.
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Weller Mfg. Co., Chicago, Ill.

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Cincinnati Rubber Mfg. Co., Cincinnati, O.
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Penna Flexible Metallic Tubing Co., Phila., Pa.
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Buff & Buff Mfg. Co., Boston, Mass.
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Gurley, W. & L. E., Troy, N. Y.
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Koleseh & Co., New York.
Lietz Co., A., San Francisco, Cal.
Leupold & Voelpel, Portland, Ore.
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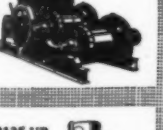

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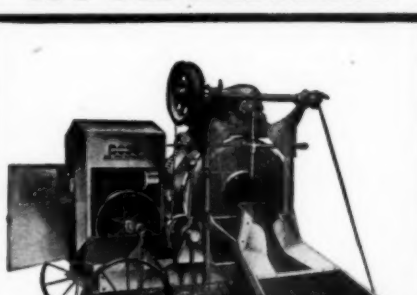

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Milwaukee Corrugating Co., Milwaukee, Wis.
Northwestern Expanded Metal Co., Chicago, Ill.
Penn Metal Co., Boston, Mass.
Sykes Metal Lath & Roofing Co., Niles, O.
Youngstown Pressed Steel Co., Warren, O.

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Coldwell Lawn Mower Co., Newburgh, N. Y.
Gilson Mfg. Co., Port Washington, Wis.
Ideal Power Lawn Mower Co., Lansing, Mich.
Jacobsen Mfg. Co., Racine, Wis.
Penna. Lawn Mower Works, Philadelphia, Pa.
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Chicago Flexible Shaft Co., Chicago, Ill.
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Chain Belt Co., Milwaukee, Wis.
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Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Nelson Iron Wks., Brooklyn, N. Y.
Portable Machy. Co., Passaic, N. J.
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Smith Co., T. L., Milwaukee, Wis.
Weller Mfg. Co., Chicago, Ill.

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Medart Mfg. Co., Fred., St. Louis, Mo.

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Davenport Locomotive Works, Davenport, Ia.
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Lima Locomotive Wks., Lima, O.
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Milwaukee Locomotive Mfg. Co., Milwaukee, Wis
Vulcan Iron Works, Wilkes-Barre, Pa.
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Crowell & Spencer Lumber Co., Long Leaf, La.
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Great Southern Lumber Co., Bogalusa, La.
Industrial Lumber Co., Elizabeth, La.
Long Bell Lumber Co., Kansas City, Mo.
Sargent Lumber Co., Little Rock, Ark.
Storner Co., Inc., E. J., New York
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General Fireproofing Co., Youngstown, O.
National Pressed Steel Co., Massillon, O.

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METAL LATH. (See "Lath")

METAL ROOFING (See "Roofing)

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*Ford Meter Box Co., Wabash, Ind.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Mueller Mfg. Co., H., Decatur, Ill.

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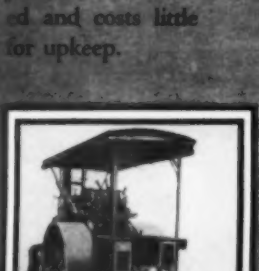

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American Meter Co., New York
Bailey Meter Co., Cleveland, O.
Builders Iron Fdry., Providence, R. I.
Cleveland Gas Meter Co., Cleveland, O.

METERS, WATER

*Badger Meter Mfg. Co., Milwaukee, Wis.
*Neptune Meter Co., New York.
*Pittsburgh Meter Co., E. Pittsburgh, Pa.
*Union Water Meter Co., Worcester, Mass.
Buffalo Meter Co., Buffalo, N. Y.
Federal Meter Co., Brooklyn, N. Y.
Gamon Meter Co , Newark, N. J.
Hersey Mfg. Co., Boston, Mass.
National Meter Co., New York.
Thomson Meter Co., Brooklyn, N. Y.
Worthington Pump & Mchy. Corp., New York.

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Simplex Valve & Meter Co., Philadelphia, Pa.

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Kent Machine Co., Kent, O.
Lakewood Engineering Co., Cleveland, O.
Union Iron Works, Inc., Hoboken, N. J.

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*Barber Asphalt Co., Philadelphia, Pa.
*Koehring Co., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Kent Machine Co., Kent, O.

MIXERS, MORTAR

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*Blaw-Knox Co., Pittsburgh, Pa.
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Austin Machinery Corp'n, Toledo, O.
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Construction Machinery Co., Waterloo, Ia
Kent Machine Co., Kent, O.
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Lansing Co., Lansing, Mich.
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Marsh-Capron Co., Chicago, Ill.
Smith Co., T. L., Milwaukee, Wis.

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Excelsior Motor Mfg. & Supply Co., Chicago, Ill.
Harley-Davidson Motor Co., Milwaukee, Wis.
Indian Motocycle Co., Springfield, Mass.

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Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Holtzer-Cabot Elec. Co., Boston, Mass.
Lincoln Elec. Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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Continental Motors Corp., Detroit, Mich.
Herschell-Spillman Co., No. Tonawanda, N. Y.
Hinkley Motors, Inc., Detroit, Mich.
Waukesha Motor Co., Waukesha, Wis.
Wisconsin Motor Mfg. Co., Milwaukee, Wis.

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*Garford Motor Truck Co., Lima, O.
*General Motors Truck Co., Pontiac, Mich.
*International Motor Co., New York.
Acme Motor Truck Co., Cadillac, Mich.
Atterbury Motor Car Co., Buffalo, N. Y.
Autocar Co., Ardmore, Pa.
Bessemer Motor Truck Co., Grove City, Pa.
Brockway Motor Truck Co., Cortland, N. Y.
Clydesdale Motor Truck Co., Clyde, O.
Corbitt Motor Truck Co., Henderson, No. Car.
Denby Motor Truck Co., Detroit, Mich
Diamond T. Motor Car Co., Chicago, Ill.
Duplex Truck Co., Lansing, Mich.
Federal Motor Truck Co., Detroit, Mich.
Four Wheel Drive Auto Co., Clintonville, Wis.
Gramm Bernstein Motor Truck Co., Lima, O.
Indiana Truck Corp'n., Marion, Ind.
International Harvester Co., Chicago, Ill.
Kelly Springfield Motor Truck Co., Springfield, O.
Kissel Motor Car Co., Hartford, Wis.
Larrabee-Deyo Motor Tr. Co., Binghamton, N.Y.
Nash Motors Co., Kenosha, Wis.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Republic Motor Truck Co., Alma, Mich.
Rowe Motor Mfg. Co., Lancaster, Pa.
Service Motor Truck Co., Wabash, Ind.
Sterling Motor Truck Co., Milwaukee, Wis.
Stewart Motor Corp'n., Buffalo, N. Y.
Tiffin Wagon Co., Tiffin, O.
Titan Motor Truck Co., Milwaukee, Wis.
Traffic Motor Truck Co., St. Louis, Mo.
Transport Truck Co., Mt. Pleasant, Mich.
U. S. Motor Truck Co., Cincinnati, O.
Ward LaFrance Truck Co., Elmira, N. Y.
Wilson Co., J. C., Detroit, Mich.
White Co., Cleveland, Ohio.

MOULDS, CONCRETE

*Blaw-Knox Co., Pittsburgh, Pa.

NUMBERS, HOUSE (See "House Numbers")

OAKUM

Wall Rope Works, Beverly, N J.

OILS, ROAD

*Barber Asphalt Co., Philadelphia, Pa.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Company, New York.
Atlantic Refining & Asphalt Corp'n, Philadelphia
Barrett Co., New York.
Headley Good Roads Co., Philadelphia, Pa
Pierce Oil Corp., New York.
Sinclair Refining Co., Chicago, Ill.
Standard Oil Co., (La.) New Orleans, La.
Standard Oil Co., (N. J.) Newark, N. J.
Standard Oil Co. (N. Y.), New York.
U. S. Asphalt Refining Co., New York.

OXY-ACETYLENE APPARATUS

Oxweld Acetylene Co., Newark, N. J.

OXYGEN

Linde Air Products Co., New York.

PACKING, WATER PIPE

*Union Water Meter Co., Worcester, Mass.
Leadite Co., The, Philadelphia, Pa.
United Lead Company, New York.

PAINT GUNS

*Spray Eng. Co., Boston, Mass.

PAINTS, METAL PROTECTION

*Barber Asphalt Co., Philadelphia, Pa.
*Dixon Crucible Co., Jos., Jersey City, N. J.

The Bear Tractor

Speed–Quick Turning–Easy Control —These You Need for Road Patrol —And These You Have in the Bear

AS ONE man said, "It seems the Bear is *specially made* for nearly *every* job." The truth is, practically *every* feature in the Bear is of advantage in *every* kind of tractor work. So, while the Bear is termed a *universal* tractor, most Bear owners feel that it was designed *especially* for them.

And no where is this feeling more pronounced than among the men who are doing road patrol work. If all your other tractor work were eliminated from consideration, it is doubtful if a better tractor could be built at the present time for road patrol.

Not only is the Bear *fast,* not only is it *quick at the turn,* not only is it *easy to control*—but it supplies *cheap* power, whether pulling a half load or a full load. Its power flexibility, its efficiency in delivering its power to the drawbar, its economy in fuel and oil consumption, its low upkeep as illustrated in the track—these are some of the reasons *why* the Bear supplies cheap power for road maintenance.

It will cost you nothing to learn a lot more about the Bear Tractor. A book, just published, will be sent to you on request.

BEAR TRACTORS INC. 5333 PARK PLACE NEW YORK, N. Y.

The Tractor that Delivers its Power to the Drawbar

*Semet-Solvay Co., Syracuse, N. Y.
*Truscon Laboratories, Detroit, Mich.
Acme White Ld. & Col. Works, Detroit, Mich.
Barrett Co., New York.
Berry Bros., Detroit, Mich.
Carey Co., Philip, Cincinnati, Ohio.
Cook Paint & Varnish Co., Kansas City, Mo.
Detroit Graphite Co., Detroit, Mich.
Detroit White Lead Wks., Detroit, Mich.
Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
Minwax Co., New York.
Protexol Corpn., New York.
Ruberoid Co., New York.
Sherwin-Williams Co., Cleveland, O.
Sonneborn Sons, Inc., L., New York.
Toch Bros., New York.
Tropical Paint & Oil Co., Cleveland, Ohio.
Truscon Laboratories, Detroit, Mich.

PAPERS, BLUE PRINT AND BROWN PRINT
Indianapolis Blue Print & Supply Co., Indianapolis, Ind.

PAPER, BUILDING, ROOFING, ETC.
*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
Barrett Co., New York.
Bird & Son, Inc., E. Walpole, Mass.
Brown Co., Portland, Me.
Hydrex Asphalt Products Corp., New York.
Johns-Manville, Inc., New York.
National Roofing Co., Tonawanda, N. Y.
Ruberoid Co., New York.

PARK BENCHES
Art Concrete Works, Pasadena, Calif.
Bausman Mfg. Co., Bausman, Pa.
Dow Co., Louisville, Ky.
Mott Iron Wks., J. L., New York.
Stewart Iron Works, Cincinnati, Ohio.

PAVING AND ROAD ROLLERS (See Road and Paving Rollers)

PAVING BLOCKS, CREOSOTED WOOD
American Creosote Wks., Inc., New Orleans, La.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Compressed Wood Preserving Co., Cincinnati, O.
Creosoted Materials Co., New Orleans, La.
Jennison-Wright Co., Toledo, O.
Republic Creosoting Co., Indianapolis, Ind.
Wyckoff Pipe & Creosoting Co., New York.

PAVING BRICK
Albion Shale Brick Co., Albion, Ill.
Alton Brick Co., Alton, Ill.
Barr Clay Co., Streator, Ill.
Binghamton Brick Co., Binghamton, N. Y.
Burton Townsend Co., Zanesville, O.
Cleveland Brick & Clay Co., Cleveland, O.
Clydesdale Brick & Stone Co., Pittsburgh, Pa.
Coffeyville Vit. Brick & Tile Co., Coffeyville, Kans.
Corry Brick & Tile Co., Corry, Pa.
Flint Brick Co., Des Moines, Ia.
Francis Vit. Brick Co., Boynton, Okla.
Georgia Brick & Tile Co., Adairsville, Ga.
Hammond Fire Brick Co., Fairmont, W. Va.
Hocking Valley Brick Co., Columbus, O.
Hydraulic Press Brick Co., St. Louis, Mo.
Independence Pav. Br. Co., Independence, Kans.
McAvoy Vit. Brick Co., Philadelphia, Pa.
Mack Mfg. Co., Wheeling, W. Va.
Mayer Brick Co., C. P., Bridgeville, Pa.
Medal Paving Brick Co., Cleveland, O.
Metropolitan Paving Brick Co., Canton, O.
Mineral Wells Pav. Brick Co., Mineral Wells, Tx.
Moberly Paving Brick Co., Moberly, Mo.
Murphysboro Paving Brick Co., Murphysboro, Ill.
Patton Clay Mfg. Co., Patton, Pa.
Peebles Brick Co., Portsmouth, O.
Penna. Clay Co., Pittsburgh, Pa.
Pittsburgh Paving Brick Co., Pittsburgh, Kas.
Poston Paving Brick Co., Crawfordsville, Ind.
Purington Paving Brick Co., Galesburg, Ill.
Southern Clay Mfg. Co., Chattanooga, Tenn.
Springfield Paving Brick Co., Springfield, Ill.
Sterling Brick Co., Olean, N. Y.
Streator Clay Mfg. Co., Streator, Ill.
Thornton Fire Brick Co., Clarksburg, W. Va.
Thurber Brick Co., Thurber, Texas.
Toronto Fire Clay Co., Toronto, Ohio.
Trinidad Brick & Tile Co., Trinidad, Colo.
Veedersburg Paver Co., Veedersburg, Ind.
Western Clay Mfg. Co., Helena, Mont.
Westport Paving Brick Co., Westport, Md.

PAVING MACHINERY. (See Road and Paving Machinery)

PAVING GUARDS, STEEL
*Godwin Co., W. S., Baltimore, Md.
International Steel Tie Co., Cleveand, O.

PAVING MATERIALS (See "Asphalt," "Paving Brick," "Granite Block," etc.)

PAVING MIXERS. (See Concrete Mixers)

PAVING TOOLS
*Barber Asphalt Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros. Co., Cincinnati, O.
*Warren Bros. Co., Boston, Mass.
Anderson Tool & Sup. Co., W. H., Detroit, Mich
Cummer & Sons Co., F. D., Cleveland, O.
Union Iron Works, Hoboken, N. J.

PERFORATED METALS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.

PICKS
Beall Tool Co., East Alton, Ill.
Hubbard Co., Pittsburgh, Pa.
Iron City Tool Works, Pittsburgh, Pa.
Klein-Logan Co., Pittsburgh, Pa.
Verona Tool Works, Verona, Pa.
Warren Tool & Forge Co., Warren, O.
Warwood Tool Co., Wheeling, W. Va.
Wyoming Shovel Wks., Wyoming, Pa.

PILE DRIVERS
*McKiernan-Terry Drill Co., New York.
Browning Co., Cleveland, O.
Clyde Iron Works Sales Co., Duluth, Minn.
Industrial Works, Bay City, Mich.
Lidgerwood Manufacturing Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
McMyler Interstate Co., Cleveland, O.
Union Iron Works, Hoboken, N. J.

PILE HAMMERS, STEAM
*McKiernan-Terry Drill Co., New York.
Clyde Iron Works Sales Co., Duluth, Minn.
Industrial Works, Bay City, Mich.
National Hoisting Eng. Co., Harrison, N. J.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Chicago, Ill.

PILING, CONCRETE
MacArthur Concrete Pile & Foundation Co., N.Y.
Raymond Concrete Pile Co., New York.

PILING, INTERLOCKING STEEL
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.

PIPE, CAST IRON
*Central Foundry Co., New York.
*U. S. Cast Iron Pipe & Fdy. Co., Burlington, N.J
American Cast Iron Pipe Co., Birmingham, Ala.
Clow & Sons, J. B., Chicago, Ill.
Donaldson Iron Co., Emaus, Pa.
Fox & Co., John, New York.
Glamorgan Pipe & Fdry. Co., Lynchburg, Va.
Lynchburg Foundry Co., Lynchburg, Va.
National Cast Iron Pipe Co., Birmingham, Ala
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Warren Fdry. & Machine Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE, CULVERT (See Culverts)

PIPE, LEAD
United Lead Company, New York

PIPE, REINFORCED CONCRETE
Concrete Products Co., Pittsburgh, Pa.
Core Joint Concrete Pipe Co., Baltimore, Md.
Independent Concrete Pipe Co., Indianapolis Ind.
Lock Joint Pipe Co., E. Orange, N. J.
Massey Concrete Products Corp'n, Chicago, Ill

PIPE, RIVETED STEEL
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros. Cincinnati, Ohio.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.

Fullerton Parkway, Chicago, Ill., Tarvia-built 1909. Note excellent condition of street after fifteen years of uninterrupted service.

This Car?
Only a memory today

—but the road *lasted!*

More miles of good roads—
Most years of satisfactory road service

MOTORING in 1909—terrified horses, "funny-acting" tires, rear door tonneaus. The man who owned the car shown above remembers it all. He used to parade Chicago's streets in his ark-on-wheels. He remembers when Fullerton Parkway's Tarvia Pavement was laid back in 1909.

Fifteen years ago — fifteen years of grinding motor traffic—yet Fullerton Parkway lasted—is a good road today.

Tarvia Roads can be maintained indefinitely at little cost. In other words: only economical maintenance is needed to make a Tarvia Road last indefinitely.

Now tack these points on:

1. A Tarvia Road will not wave, roll or rut.
2. A Tarvia road is skidproof, because of its granular surface.

Thousands of Tarvia streets and roads have proved to tax payers that—

For the money spent—Tarvia gives more miles of good roads and the most years of satisfactory road service.

Every paving requirement—construction, repair or maintenance—can be met with Tarvia.

Tarvia
For Road Construction Repair and Maintenance

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New York, Chicago, Philadelphia, Boston
St. Louis, Cleveland, Cincinnati, Pittsburgh
Detroit, Kansas City, Birmingham, Dallas
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Youngstown, Milwaukee, Toledo, Columbus
Baltimore, Syracuse, New Orleans, Rochester

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Canton Culvert & Silo Co., Canton, O.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
East Jersey Pipe Co., New York.
Hammond Iron Works, Warren, Pa.
Hardesty Mfg. Co., R., Denver, Col.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa
Tippet & Wood, Phillipsburg, N. J.
Welter Mfg. Co., Chicago, Ill.

PIPE, SPIRAL RIVETED

Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.

PIPE STEEL

East Jersey Pipe Co., New York.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Steel & Tube Co. of Am., Chicago, Ill.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE, WOOD

American Wood Pipe Co., Tacoma, Wash.
Continental Pipe Mfg. Co., Seattle, Wash.
Michigan Pipe Co., Bay City, Mich.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Mfrs. Co., San Francisco, Cal.
Standard Wood Pipe Co., Williamsport, Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE, WROUGHT IRON

Byers Co., A. M., Pittsburgh, Pa.
Reading Iron Co., Reading, Pa.

PIPE BENDING MACHINES

Amer. Pipe Bending Mach. Co., Boston, Mass.
Walworth Mfg. Co., Boston, Mass.

PIPE COVERING

AIRCELL

*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.
Nat'l Asbestos Co., Jersey City, N. J.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mt. Co., Chicago, Ill.
Watson Co., H. F., Erie, Pa.

85 PER CENT MAGNESIA

*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.

WOOD

Continental Pipe Mfg. Co., Seattle, Wn.
Redwood Mfrs. Co., San Francisco, Cal.
Ric-Wil Co., Cleveland, O.
Wyckoff & Son Co., A., Elmira, N. Y.

PIPE CUTTERS. **(See Cutters, Pipe, Hand.)**

PIPE FITTINGS

*Central Foundry Co., New York.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
American C. I. Pipe Co., Birmingham, Ala.
Builders Iron Fdry, Providence, R. I.
Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Bridgeport, Conn.
Warren Fdry. & Mach. Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE HANDLING MACHINERY

Mueller Mfg. Co., H., Decatur, Ill.
Taylor Portable Steel Derrick Co., Chicago, Ill

PIPE JOINT COMPOUND. **(Sewer)**

*Carey Co., Philip, Cincinnati, Ohio.
*Waring-Underwood Co., Philadelphia, Pa.
G. K. Sales Co., Macungie, Pa.
Leadite Company, Inc., Philadelphia, Pa.
Pacific Flush Tank Co., Chicago, Ill.
Ruberoid Co., New York.

PIPE JOINT MATERIAL. **(Cast Iron)**

Lead-Hydro-Tite Co., Boston, Mass.
Leadite Co., The, Philadelphia, Pa.
United Lead Co., New York.

PLAYGROUND APPARATUS

American Playground Device Co., Anderson, Ind
Everwear Mfg. Co., Springfield, O.
Exerawing Co., Minneapolis, Minn.
George, Howard, Philadelphia, Pa.
Hill-Standard Co., Anderson, Ind.
Medart Mfg. Co., Fred., St. Louis, Mo.
Spalding & Bros., A. G., Chicopee, Mass.

PLOWS, CONTRACTORS

*Adams & Co., J. D., Indianapolis, Ind.
*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.
*Holt Mfg. Co., Peoria, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Steel Scraper Co., Sidney, O.
Avery Co., Peoria, Ill.
Deere & Co., Moline, Ill.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y
International Harvester Co., Chicago, Ill.
Moline Plow Co., Rock Island, Ill.
Oliver Chilled Plow Works, South Bend, Ind.
Sidney Steel Scraper Co., Sidney, O.
Smith & Sons Mfg. Co., Kansas City, Mo.
Western Wheeled Scraper Co., Aurora, Ill.
Wiard Plow Co., Batavia, N. Y.

PLUMBING SUPPLIES

Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Glauber Brass Mfg. Co., Cleveland, O.
Mott Iron Wks., J. L., New York
Mueller Mfg. Co., H., Decatur, Ill.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
United Brass Mfg. Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

POLES, STEEL STRUCTURAL

*Blaw-Knox Co., Pittsburgh, Pa.
Electric Railway Equipment Co., Cincinnati, O.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa

PORTABLE BUILDINGS

*Blaw-Knox Co., Pittsburgh, Pa.
*Littleford Bros., Cincinnati, Ohio.
*Truscon Steel Co., Youngstown, O.
Milwaukee Corrugating Co., Milwaukee, Wis
Pruden Co., C. D., Baltimore, Md.

PORTABLE STEEL DERRICKS. **(See Derricks, Steel Portable.)**

PORTLAND CEMENT. **(See Cement.)**

POWDER. **(See Explosives.)**

PUMPS, AIR LIFT

Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

PUMPS, BOILER FEED

Advance Pump & Compr. Co., Battle Creek, Mich
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Works, A. S., New York
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
LeCourtenay Co., Newark, N. J.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Northern Fire Apparatus Co., Minneapolis, Minn.
Scranton Pump Co., Scranton, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Vogt Bros. Mfg. Co., Louisville, Ky.
Warren Steam Pump Co., Warren, Mass.
Weinman Pump Mfg. Co., Columbus, O.
Yeomans Bros. Co., Chicago, Ill.

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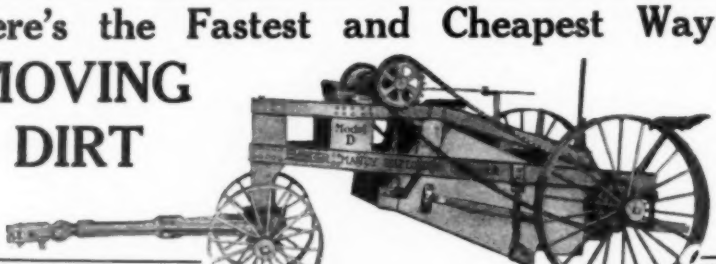
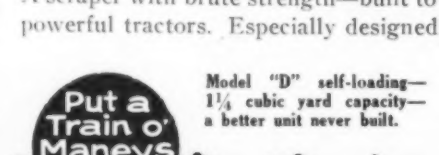


The New Maney Scraper

A scraper with brute strength—built to stand the "tough going" behind heavy powerful tractors. Especially designed for speed and over-load capacity.



Model "D" self-loading—1¼ cubic yard capacity—a better unit never built.

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Get direct from us the real facts about these horseless scrapers.

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BUFFALO-SPRINGFIELD ROLLERS

All Types and Sizes

With or without Scarifier attachment.

Helps you finish the job on time.

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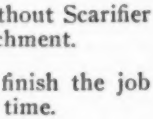
Springfield, Ohio.



PUMPS, CENTRIFUGAL

*Keystone Driller Co., Beaver Falls, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Domestic Engine & Pump Co., Shippensburg, Pa.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
LeCourtenay Co., Newark, N. J.
Manistee Iron Wks., Manistee, Mich.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Schramm, Inc., West Chester, Pa.
United Iron Works, Kansas City, Mo.
Wheeler Condenser & Eng. Co., Carteret, N. J.
Worthington Pump & Mchy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, CONTRACTORS'

*Kinney Mfg. Co., Boston, Mass.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Buda Co., Harvey, Ill.
Cameron Steam Pump Works, A. S., New York.
Carter Co., Ralph B., New York.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Ia.
Dayton-Dowd Co., Quincy, Ill.
Deming Co., Salem, Ohio.
Domestic Engine & Pump Co., Shippensburg, Pa.
Emerson Pump & Valve Co., Alexandria, Va.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
LeCourtenay Co., Newark, N. J.
McGowan Co., J. B., Cincinnati, O.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Myers & Bro. Co., F. E., Ashland, O.
Northern Fire App. Co., Minneapolis, Minn.
Novo Engine Co., Lansing, Mich.
Pulsometer Steam Pump Co., New York.
Schramm, Inc., West Chester, Pa.
Smith Co., T. L., Milwaukee, Wis.
Standard Scale & Supply Co., Pittsburgh, Pa.
Van Neuhuys Machine Wks., Albany, N. Y.
Waldo Bros. & Bond Co., Boston, Mass.

PUMPS, DEEP WELL

*Aldrich Pump Co., Allentown, Pa.
*Clark Co., H. W., Mattoon, Ill.
*Keystone Driller Co., Beaver Falls, Pa.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York
Cook, Inc., A. D., Lawrenceburg, Ind.
Deming Co., Salem, O.
Domestic Engine & Pump Co., Shippensburg, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Layne & Bowler Co., Memphis, Tenn.
McDonald Mfg. Co., A. Y., Dubuque, Ia.
Midwest Engine Co., Indianapolis, Ind.
Myers & Bro. Co., F. E., Ashland, O.
United Iron Works, Kansas City, Mo.
Weber Subterranean Pump Co., New York.

PUMPS, DREDGING

*Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Wks., A. S., New York.
Erie Pump & Engine Co., Medina, N. Y.
Morris Machine Works, Baldwinsville, N. Y.
Rumsey Pump Co., Ltd., Seneca Falls, N. Y.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Mchy. Corp., New York.

PUMPS, GASOLINE AND OIL

*Kinney Mfg. Co., Boston, Mass.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Buda Co., Harvey, Ill.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Northern Fire App. Co., Minneapolis, Minn.
Wayne Tank & Pump Co., Fort Wayne, Ind.
Worthington Pump & Mach. Corp., New York.

PUMPS, POWER

*Kinney Mfg. Co., Boston, Mass.
*Koehring Co., Milwaukee, Wis.
Alamo Iron Works, San Antonio, Tex.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Domestic Engine & Pump Co., Shippensburg, Pa.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
Lawrence Machine Co., Lawrence, Mass.
Le-Courtenay Co., Newark, N. J.
McGowan Co., J. B., Cincinnati, O.
Myers & Bro. Co., F. E., Ashland, O.
Nordberg Mfg. Co., Milwaukee, Wis.
Northern Fire Aparatus Co., Minneapolis, Minn.
Weinman Pump Mfg. Co., Columbus, O.
Worthington Pump & Machy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, TAR AND ASPHALT

*Kinney Mfg. Co., Boston, Mass.

RAILS AND RAIL JOINTS

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

RAILROAD DITCHERS (See Excavators, Ditch and Trench.)

RECORDERS, WATER STAGE

Builders Iron Fdry., Providence, R. I.
Gurley, W. & L. E., Troy, N. Y.

REFRIGERATING MACHINERY. (See Ice Making Machinery.)

REINFORCING CONCRETE. (See Concrete Reinforcements.)

RIVETERS, PNEUMATIC

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Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Hanna Eng. Works, Chicago, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Watson-Stillman Co., New York.

RIVET SETS

Cleveland Pneumatic Tool Co., Cleveland, O.
Dunbar Drop Forge Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

RIVETS, BRIDGE AND STRUCTURAL. (See Bolts, Nuts, Etc.)

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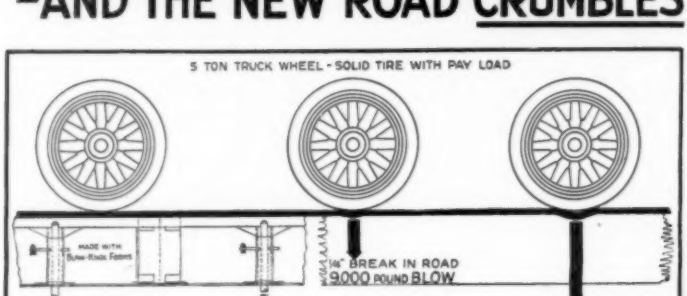
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Monroe & Sons, N. S., Arthur, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Stockland Road Mach. Co., Minneapolis, Minn.
Case Threshing Machine Co., J. I., Racine, Wis.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyle Culv & Rd. Equip. Co., Minneapolis, Minn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Smith & Sons Mfg. Co., Kansas City, Mo.

ROAD OILS. (See Oils, Road.)

Bang! Jolt! Smash!

—AND THE NEW ROAD CRUMBLES


5 TON TRUCK WHEEL - SOLID TIRE WITH PAY LOAD
MADE WITH BLAW-KNOX FORMS
SMOOTH ROAD
NO IMPACT
½" BREAK IN ROAD
9000 POUND BLOW
2" BREAK IN ROAD
29,000 POUND BLOW

This is what happens when the road is wavy, has obstructions or breaks.

And the pity of it is, that with the right care in finishing, it is JUST AS EASY AND CHEAP to build smooth roads with

BLAW-KNOX ROAD FORMS

*** this remark is significant. *A. T. GOLDBECK, Chief of Division of Tests, U.S. Bureau of Public Roads, says:* "Unevenness of side forms is an inexcusable construction defect and results in an uneven surface."

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Road Forms
Universal Forms
Truck Turntables
Batcherplants
Handy Houses
Clamshell Buckets
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District Offices
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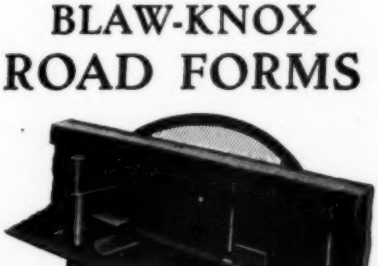

This staking and keying system prevents settlement.

This is the famous lock-joint connection—it holds the form in rigid alignment and grade.

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667 Farmer's Bank Building ~ ~ ~ Pittsburgh, Pa.

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*Buffalo Springfield Roller Co., Springfield, O.
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*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach. Co., Kennett Square, Pa.
*Huber Mfg. Co., Marion, O.
Avery Co., Peoria, Ill.
Bucyrus Road Machy. Co., Bucyrus, O.
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*Atlas Engineering Co., Milwaukee, Wis.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Barber Asphalt Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co, Springfield, O.
*Connery & Co., Inc., Philadelphia, Pa.
*Erie Machine Shops, Erie, Pa.
*Equitable Asph. Maint. Co., Kansas City, Mo.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach. Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Holt Mfg. Co., Peoria, Ill.
*International Motor Co., New York.
*Kinney Mfg. Co., Boston, Mass.
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*Monroe & Sons, N. S., Arthur, Ill.
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Aultman & Taylor Mach. Co., Mansfield, Ohio.
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Avery Co., Peoria, Ill.
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Case Threshing Mach. Co., J. I. Racine, Wis.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Mach. Co., Lima, O.
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Glide Road Mach'y Co., Minneapolis, Minn.
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Lakewood Engineering Co., Cleveland, O.
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United Iron Works, Kansas City, Mo.

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ROCK DRILLS. (See Drills, Rock)

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*Carey Co., Philip, Cincinnati, Ohio.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
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Atlantic Refining & Asphalt Corp., Phila., Pa.
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Beaver Board Cos., Buffalo, N. Y.
Bird & Son, Inc., E. Walpole, Mass.
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Edwards Mfg. Co., Cincinnati, O.
Flintkote Co., Boston, Mass.
Johns-Manville, Inc., New York.
Keystone Roofing Mfg. Co., York, Pa.
Lehon Co., The, Chicago, Ill.
Lewis Mfg. Co., F. J., Chicago, Ill.
National Roofing Co., Tonawanda, N. Y.
Ruberoid Co., New York.
Sall Mountain Co., Chicago, Ill.
Sifo Products Co., St. Paul, Minn.
Sonneborn & Sons, Inc., L., New York.
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Western Elaterite Roofing Co., Denver, Colo.

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American Rolling Mill Co., Middletown, Ohio.
Berger Mfg. Co., Canton, O.
Edwards Mfg. Co., Cincinnati, O.
Klauer Mfg. Co., Dubuque, Ia.
Milwaukee Corrugating Co., Milwaukee, Wis.
Nat'l Sheet Metal Roofing Co., Jersey City, N. J.
United Alloy Steel Corpn., Canton, O.
Youngstown Sheet & Tube Co., Youngstown, O.

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Columbian Rope Co., Auburn, N. Y.
Cupples Cordage Co., Brooklyn, N. Y.
Hooven & Allison Co., Xenia, O.
Kelly Co., R. A., Xenia, O.
New Bedford Cordage Co., New Bedford, Mass.
Peoria Cordage Co., Peoria, Ill.
Plymouth Cordage Co., N. Plymouth, Mass.
Wall Rope Wks., New York.
Waterbury Co., New York.
Whitlock Cordage Co., New York.

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Broderick & Bascom Rope Co., St. Louis, Mo.
Leschen & Sons Rope Co., A., St. Louis, Mo.
MacWhyte Co., Kenosha, Wis.
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Roebling's Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.
Waterbury Co., New York.
Wickwire Spencer Steel Corp., New York.
Williamsport Wire Rope Co., Williamsport, Pa.

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RULES
*Lufkin Rule Co., Saginaw, Mich.

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*Good Roads Mach. Co., Kennett Square, Pa.
*Huber Mfg. Co., Marion, O.
*Kinney Mfg. Co., Boston, Mass.
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*Universal Road Machinery Co., Kingston, N. Y.
Acme Road Mach. Co., Frankfort, N. Y.
Avery Co., Peoria, Ill.
Case Threshing Mach. Co., J. I., Racine, Wis.
Lyle Cul. & Rd. Equip. Co., Minneapolis, Minn.

SCARIFIERS, TEETH FOR
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*Sauerman Bros., Chicago, Ill.

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*Baker Mfg. Co., Springfield, Ill.
*Galion Iron Works & Mfg. Co., Galion, O.
*Good Roads Mach. Co., Kennett Square, Pa.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Acme Road Mach. Co., Frankfort, N. Y.
Avery Co., Peoria, Ill.
Case Threshing Machine Co., J. I., Racine, Wis.
East Iron & Machine Co., Lima, O.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
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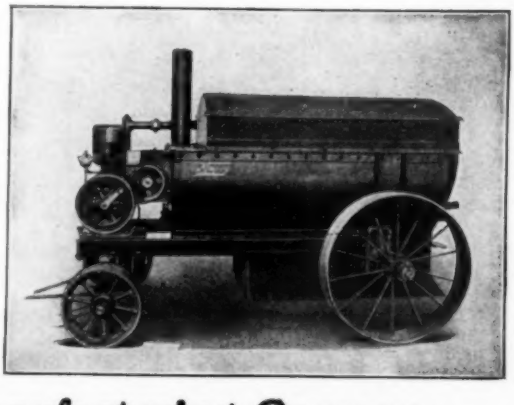

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*Robins Conv. Belt Co., New York.
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Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., Cleveland, O.
Case Threshing Machine Co., J. I., Racine, Wis.
Chain Belt Co., Milwaukee, Wis.
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Gifford-Wood Co., Hudson, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
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Newaygo Eng. Co., Newaygo, Mich.
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Sackett Screen & Chute Co., H. B., Chicago, Ill.
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Weller Mfg. Co., Chicago, Ill.
Wickwire Spencer Steel Corp., New York.

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Link-Belt Co., Philadelphia, Pa.
Sanitation Corp'n, New York.

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Clark Bros. Bolt Co., Milldale, Conn.
St. Louis Screw Co., St. Louis, Mo.

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Dorr Co., New York
Pacific Flush Tank Co., Chicago, Ill.
Sanitation Corp'n, New York.

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SEWAGE EJECTORS
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Sanitation Corp'n, New York.
Yeomans Bros. Co., Chicago, Ill.

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Denver Sewer Pipe & Clay Co., Denver, Col.
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Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Laclede Christy Clay Products Co., St. Louis, Mo.
Macomb Sewer Pipe Wks., Macomb, Ill.
Pacific Clay Products Co., Los Angeles, Cal.
Red Wing Sewer Pipe Co., Red Wing, Minn.
Robinson Clay Product Co., Akron, O.
Standard Fire Brick & Sewer Pipe Co., Pueblo, Col.

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Self Propelling Nozzle Co., New York.
Thompson Sewer Machine Co., Buffalo, N. Y.
Turbine Sewer Machine Co., Milwaukee, Wis.

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Blackmer & Post Pipe Co., St. Louis, Mo.
Dee Co., Wm. E., Chicago, Ill.
Delaware Clay Products Co., Pittsburgh, Pa.
Denver Sewer Pipe & Clay Co., Denver, Col.
National Fireproofing Co., Pittsburgh, Pa.
Ohio Vitrified Pipe Co., Uhrichsville, O.
Robinson Clay Product Co., Akron, O.

SEWER RODS
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Champion Corporation, Hammond, Ind.
Turbine Sewer Machine Co., Milwaukee, Wis.

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Edwards Mfg. Co., Cincinnati, Ohio.
Eller Mfg. Co., Canton, Ohio.
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Penn Metal Co., Boston, Mass.
Klauer Mfg. Co., Dubuque, Ia.
Tiffin Art Metal Co., Tiffin, Ohio.
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Marion Steam Shovel Co., Marion, O.
Thew Shovel Co., Lorain, O.

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Jackson Shovel Co., Montpelier, Ind.
Pittsburgh Shovel Co., Pittsburgh, Pa.
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Wyoming Shovel Works, Wyoming, Pa.

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*Osgood Co., The, Marion, O.
American Steel Dredge Co., Fort Wayne, Ind
Bellwood Steam Shovel Co., Bellwood, Pa.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, Ohio.
Erie Steam Shovel Co., Erie, Pa.
Fairbanks Steam Shovel Co., Marion, O.
Industrial Works, Bay City, Mich.
Marion Steam Shovel Co., Marion, O.
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Union Iron Products Co., East Chicago, Ind.
Western Display & Mfg. Co., St. Paul, Minn.

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Elkhart Fdry. & Mach. Co., Elkhart, Ind.
Essco Mfg. Co., Peoria, Ill.
Federal Signal Co., Albany, N. Y.
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Little Giant Co., Mankato, Minn.
Lyle-Signs, Minneapolis, Minn
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Safety Traffic Lt. Co., Milwaukee, Wis.
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Keenan Structural Slate Co., Bangor, Pa.
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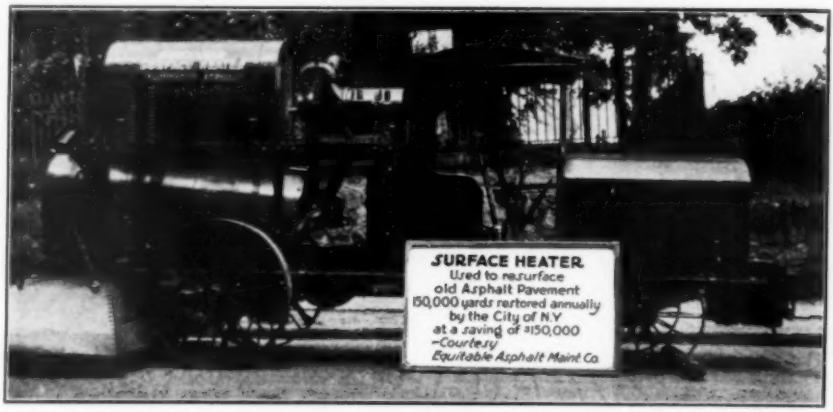

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KANSAS CITY MISSOURI

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delivering gravel to a small screening plant

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Chicago Bridge & Iron Works, Chicago, Ill.
Honhorst Co., Jos., Cincinnati, O.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

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Caldwell Co., W. E., Louisville, Ky.
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United Iron Works, Kansas City, Mo.
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Chicago Bridge & Iron Works, Chicago, Ill.
Graver Corporation, E. Chicago, Ind.
Heltzel Steel Form & Iron Co., Warren, O.
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Honhorst Co., Jos., Cincinnati, Ohio.
McClintic-Marshall Co., Pittsburgh, Pa.
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Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Toledo Crane Co., Toledo, O.
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Vulcan Iron Works, Jersey City, N. J.
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Etnyre & Co., E. D., Oregon, Ill.
Federal Motor Truck Co., Detroit, Mich.
Packard Motor Car Co., Detroit, Mich.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Tiffin Wagon Co., Tiffin, O.
White Co., Cleveland, O.

STREET LAMP POSTS
Clow & Sons, J. B., Chicago, Ill.
Drake Mfg. Co., Friendship, N. Y.
Electric Railway Equipment Co., Cincinnati, O.
General Electric Co., Schenectady, N. Y.
King Mfg. Co., Chicago, Ill.
Massey Concrete Products Co., Chicago, Ill.
Mott Iron Wks., J. L., New York.
Union Metal Mfg. Co., Canton, O.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET SIGNS (See Signs, Street)

STREET SWEEPERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Good Roads Mach. Co., Kennett Square, Pa.
*Universal Road Machinery Co., Kingston, N. Y.
Elgin Sales Corp'n, New York.
Foamite-Childs Corp., Utica, N. Y.
Springfield Motor Sweeper Co., Springfield, O.

STREET SWEEPING BROOMS
*Littleford Bros., Cincinnati, O.
Holcomb Mfg. Co., J. L., Indianapolis, Ind.
Ind. Brush & Broom Mfg. Co., Indianapolis, Ind.
Kendallville Broom & Brush Co., Kendallville, Ind.
Lang Broom Co., Pittsburgh, Pa.
Lay Co., Jos., Ridgeville, Ind.
Milwaukee Brush Mfg. Co., Milwaukee, Wis.
Osborn Mfg. Co., Cleveland, Ohio.

STREET SWEEPING BROOMS REFILLED
*Kendallville Broom & Brush Co., Kendallville, Ind.
Lang Broom Co., Pittsburgh, Pa.

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STUMP PULLERS
Bennett & Co., H. L., Westerville, O.
Clyde Iron Works, Duluth, Minn.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Thomas Elevator Co., Chicago, Ill.

SUPERHEATERS
Babcock & Wilcox Co., New York.
Power Specialty Co., New York.
Superheater Co., New York.

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SWITCHBOARDS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
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Wagner Elec. Mfg. Co., St. Louis, Mo.
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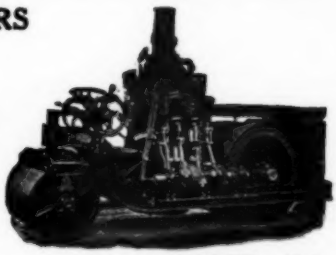

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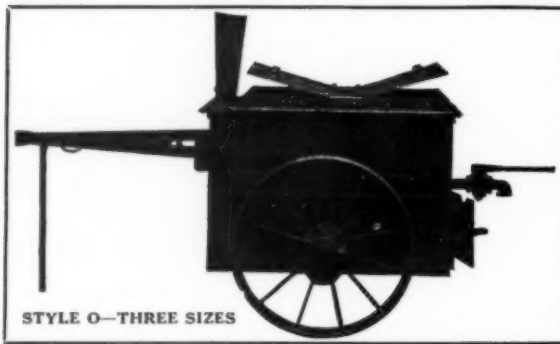

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Ingersoll-Rand Co., New York

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*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Abendroth & Root Mfg. Co., New York.
Biggs Boiler Wks., Akron, O.
Chicago Bridge & Iron Works, Chicago, Ill.
Chicago Pneumatic Tool Co., New York
Graver Corporation, E. Chicago, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Lancaster Iron Wks., Lancaster, Pa.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.
Westinghouse Tract. Brake Co., Wilmerding, Pa.
Worthington Pump & Machy. Corp., New York.

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*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Avery Co., Peoria, Ill.
Biggs Boiler Wks., Akron, O.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Case Threshing Mach. Co., J. I., Racine, Wis.
Caldwell Co., W. E., Louisville, Ky.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Dover Boiler Wks., New York.
Farrell Mfg. Co., Joliet, Ill.
Fouts Co., C. C., Middletown, O.
Graver Corporation, E. Chicago, Ind.
Hardesty Mfg. Co., R., Denver, Col.
Hendrick Mfg. Co., Carbondale, Pa.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

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Davis & Son, G. M., Palatka, Fla.
Eagle Tank Co., Chicago, Ill.
Hauser-Stander Tank Co., Cincinnati, O.
Kalamazoo Tank & Silo Co., Kalamazoo, Mich.
National Tank & Pipe Co., Portland, Ore.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Manufacturers Co., San Francisco, Calif.
Stearns Lumber Co., A. T., Boston, Mass.
U. S. Wind Engine & Pump Co., Batavia, Ill.
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Dietzgen Co., Eugene, New York.
Keuffel & Esser Co., Hoboken, N. J.
Starrett, L. S., Athol, Mass.

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Hays Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., E. Orange, N. J.

TAR

American Tar Products Co., Chicago, Ill.
Barrett Co., New York.

TAR KETTLES. (See Kettles)

TIES, STEEL

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

TIMBER CLAMPS

Pyle-Rogers Corp., New York.

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Firestone Tire & Rubber Co., Akron, O.
Fisk Tire Co., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Kelly Springfield Tire Co., New York.
Republic Rubber Co., Youngstown, O.
U. S. Tire Co., New York.

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*Littleford Bros., Cincinnati, O.

TOWERS (See Standpipe Tanks and Towers)

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Lakewood Engineering Co., Cleveland, O.

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*Bear Tractors, Inc., New York
*Best Tractor Co., C. L., San Leandro, Cal.
*Ford Motor Co., Detroit, Mich.
*Holt Mfg. Co., Peoria, Ill.
*Huber Mfg. Co., Marion, O.
*International Motor Co., New York.
Advance-Rumely Thresher Co., Laporte, Ind.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Avery Co., Peoria, Ill.
Barrett-Cravens Co., Chicago, Ill.
Bates Machine & Tractor Co., Joliet, Ill.
Case Threshing Machine Co., J. I., Racine, Wis.
Clark Trucktractor Co., Chicago, Ill.
Cleveland Tractor Co., Cleveland, O.
Dayton-Dowd Co., Quincy, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Four Wheel Drive Auto Co., Clintonville, Wis.
Hart-Parr Co., Charles City, Iowa.
International Harvester Co., Chicago, Ill.
J. T. Tractor Co., Cleveland, O.
Little Giant Co., Mankato, Minn.
Moline Plow Co., Rock Island, Ill.
Monarch Tractors, Inc., Watertown, Wis.
Oliver Tractor Co., Knoxville, Tenn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Tioga Tractor Co., Baltimore, Md.
Twin City Co., Minneapolis, Minn.
White Company, The, Cleveland, O.

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*Spray Engineering Co., Boston, Mass.
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Sewall Paint & Glass Co., Kansas City, Mo.
Tropical Paint & Oil Co., Cleveland, Ohio.
Truscon Laboratories, Detroit, Mich.

TRAFFIC SIGNS. (See "Signs, Traffic")

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Eagle Wagon Works, Auburn, N. Y.
Highway Trailer Co., Edgerton, Wis.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Lee Trailer & Body Co., Chicago, Ill.
Troy Wagon Works, Troy, O.
Warner Mfg. Co., Beloit, Wis.
Watson Products Corp'n., Canastota, N. Y.
Whitehead & Kales Co., Detroit, Mich.

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Lee Trailer & Body Co., Chicago, Ill.

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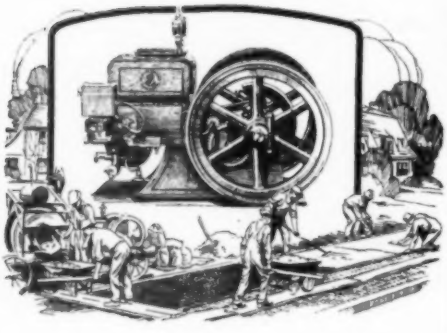

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Dodge Mfg. Corp'n, Mishawaka, Ind.
General Electric Co., Schenectady, N. Y.
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Webster Mfg. Co., Chicago, Ill.
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TRENCH EXCAVATORS, (see Excavators, Ditch & Trench)

TRENCH PUMPS. (See Pumps, Contractors')

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Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
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Western Structural Co., Moline, Ill.

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Chapman Valve Mfg. Co., Indian Orchard, Mass.
Michigan Brass & Iron Co., Detroit, Mich.
Rensselaer Valve Co., Troy, N. Y.

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Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Wks., Chattanooga, Tenn.
Crane Company, Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Inc., Bridgeport, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

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*Ludlow Valve Co., Troy, N. Y.
*U. S. C. Ir. Pipe & Fdry. Co., Burlington, N. J.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Mueller Mfg. Co., H., Decatur, Ill.
Pratt & Cady Co., Inc., Hartford, Conn.
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Edwards Mfg. Co., Cincinnati, O.
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WAGON BODIES. (See Dump Bodies)

WAGON LOADERS. (See Loaders, Gravel and Wagon)

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Bird & Son, inc., E. Walpole, Mass.
Cornell Wood Products Co., Chicago, Ill.
Haverhill Box Board Co., Haverhill, Mass.
MacAndrews & Forbes Co., New York, N. Y.
Plastergon Wall Board Co., Buffalo, N. Y.
United States Gypsum Co., Chicago, Ill.
Upson Co., The, Lockport, N. Y.
Waldorf Paper Products Co., St. Paul, Minn.

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Consolidated Expanded Metal Co., Braddock, Pa.
Berger Mfg. Co., Canton, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
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WATER MAIN TAPPING MACHINES
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., East Orange, N. J.

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*Carey Co., Philip, Cincinnati, Ohio.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Company, New York.
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Barrett Company, New York.
General Fireproofing Co., Youngstown, O.
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Minwax Co., The, New York.
Protexol Corpn., New York.
Ruberoid Co., New York.
Sandusky Cement Co., Cleveland, O.
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N. Y. Continental Jewell Filtr. Co., Nutley, N. J.
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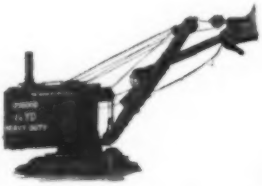

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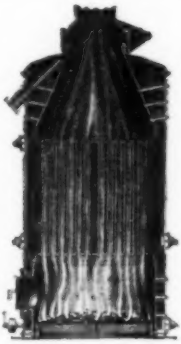

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Jackson Mfg. Co., Harrisburg, Pa.
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Bayley Co., Wm., Springfield, O.
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Friedrich Co., E. H., Holyoke, Mass.
Lupton's Sons Co., David, Philadelphia, Pa.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Sykes Co., Chicago, Ill.

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Habirshaw Elec. Cable Co., Inc., N. Y.
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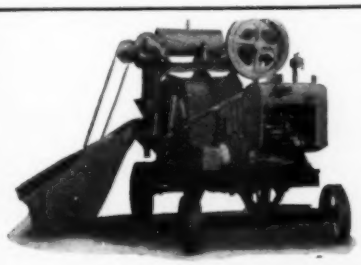

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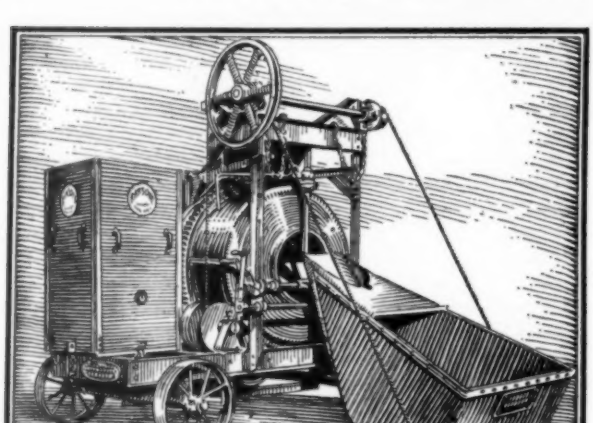

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Roughness as a Factor in Pavement Life

By A. T. Goldbeck

Bureau of Public Roads, U. S. Department of Agriculture, Washington, D. C.

THERE are certain types of road roughness, such as the inequalities in a concrete surface due to slightly projecting fine or coarse aggregate or to the brooming of the surface after finishing; the slight roughness of brick pavements due to the joints; and roughness of a similar kind in other types of roads; all of which are of little consequence in this discussion. Such slight inequalities are readily absorbed through the depression of the rubber tires, and very little vertical motion is imparted by them to the vehicle.

Roughness in Concrete Roads

There seems to be little excuse for roughness in new concrete roads constructed with the most modern methods, and yet there are many roads which, through lack of attention to every detail, are not smooth riding. Roughness in a concrete road can very readily occur if the side forms are insufficiently supported, or not sufficiently rugged, especially when a finishing machine is used, or when they are carelessly placed. Even with the smooth finish which can be accomplished, both by hand and by machine methods, a concrete road surface may still develop unevenness due to lack of homogeneity of the mixture or a non-uniform consistency, resulting in settlement of the concrete in some spots more than in others. The difficulty of maintaining a smooth surface in concrete laid on steep grades is also well known. Especially during cold weather, which interferes with rapid setting, motion of the concrete is apt to take place on hills, causing the formation of a series of waves. The difficulties of obtaining evenness at expansion joints have not in all cases been overcome. After several years of service, additional inequalities may develop due to subgrade settlement, slipping at expansion joints or heaving, or to incipient blow-ups from temperature and moisture expansion.

Rough Roads Are Rough on Traffic and on Themselves

From the standpoint of the road user, there can be no question of the desirability of as smooth a riding surface as can be produced. The instant a rough stretch of pavement is encountered, the vehicle driver is made conscious of it by reason of rapid, unpleasant vertical motion which is imparted to the entire vehicle, and a portion of which, at least, reaches the driver. He knows the exhausting effect on himself of a rough road in comparison with that of a smooth one. The vehicle owner also is quite conscious of the increased maintenance cost on his vehicle resulting from rough roads. What does this mean in terms of the life of the pavement itself?

Roughness in Bituminous and Other Types

The bituminous types are likewise difficult to finish with the desired degree of smoothness, and when the mixture or workmanship is not proper, waves develop under the combined action of traffic and warm weather. In addition, subgrade settlement is more apt to produce inequalities in roads of the flexible type than in the rigid type.

The chatterbox surface which develops in gravel roads is well known, and its effect on both the driver and the vehicle are quite apparent. Such waves seem to be caused by the combined action of the springs and the spinning of the wheels, and they increase very rapidly

unless the surface is constantly maintained. Similarly, the other types of surfaces under the action of traffic and the expanding action of heat and moisture, both in the road surface and in the subgrade, in time develop roughness of different kinds and degrees, even though they may have been reasonably smooth just after construction.

Effect of Road Roughness

Let it be assumed that a high joint has developed in a concrete road and that a motor vehicle is traveling in the direction from the

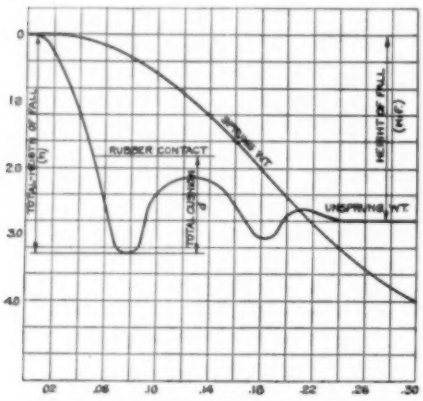


FIGURE 1. THE MOTION OF THE HUB AND BODY OF A TRUCK IN GOING OVER AN OBSTRUCTION

high side of the joint. Figure 1 illustrates the motion taken by the hub of the wheel and by the body of the machine during the time of free fall of the wheels. When the vehicle is running at high speed, for an instant the tire will be out of contact with the road surface, but immediately the force of gravity and the force due to the compression of the truck spring shoot the unsprung weight of the vehicle downward with high velocity. The body of the machine falls downward very much more slowly, since it is acted upon downward by the force of gravity alone, and this is counteracted to some extent by the upward force of the springs. When the tire comes into contact with the surface, pressure on the road is developed, which increases rapidly as the tire is compressed, and finally reaches a maximum value under the greatest flattening of the tire. The high vertical velocity of the wheel due to the kick of the spring and force of gravity is reduced to zero during the extremely short interval required to attain extreme compression of the tire. In other words, the unsprung mass of the vehicle has been decelerated and the pressure between the tire and the road surface has increased from zero at the time of initial contact to a maximum at the time of full contact.

The maximum pressure created on the road surface is entirely dependent upon the deceleration or rate of change of vertical velocity, on the mass of the unsprung portion of the vehicle, and on the spring pressure at the instant of maximum compression of the tire.

It is not necessary that sudden inequalities be present in a road surface to produce greatly increased pressure on that surface. Let us assume that a heavy vehicle is traveling at 20 miles per hour and that there is a rise in the road surface of ¼-inch in a distance of 1 foot. Let the unsprung portion of weight on one wheel be 3,000 pounds, and the sprung portion 6,000 pounds. Omitting tire compression, the vertical acceleration of the unsprung portion equals approximately 37.5 feet per second. The force on the road surface equals 12,480 pounds, as compared with 9,000 pounds, the static weight of the vehicle. This would be the force created if the tire were of steel instead of rubber. The effect of the rubber is to decrease the vertical motion of the unsprung portion of the vehicle, thereby somewhat decreasing the pressure on the road surface.

It is likewise conceivable that a wave in a road surface will lead to impact when the speed is so high that the inclined approach of the wave shoots the wheel entirely free from the surface so that it lands with a free fall.

Measurement of Impact on Road Surfaces

In 1921 a large series of tests were completed by the Bureau of Public Roads, in which it was demonstrated that rather high impact pressures were produced on the road surface under conditions of artificial roughness. These measurements were made by determining the pressure required to permanently deform a small copper cylinder placed under the plunger of a hydraulic jack buried under the road in a position to receive the impact of the motor vehicle. As a result of this series of tests, the following conclusions were at that time drawn:

Impact depends largely upon the kind and condition of the tire.

Thin or worn solid rubber tires, even though they be very wide, produce very high impact forces.

Pneumatic tires offer the greatest influence in reducing impact forces, and with their use the impact increases only very slightly with the speed of the truck.

Cushion tires, that is, tires having a degree of softness and deflection between solids and pneumatics, offer corresponding advantages in reducing impact.

Impact increases with the speed of the truck, but it cannot be said to increase according to any constant ratio or power of the speed.

Although heavy unsprung weight may give higher impact than lighter unsprung weight, it cannot be said that this is the major controlling factor.

The relative destructive effect produced by light-weight, high-speed trucks and heavy, slow-moving trucks has not been determined by these tests. They do, however, indicate that equal impact may be obtained under some conditions.

FIGURE 2. A GRAPHIC STRAIN GAGE IN POSITION ON THE UNDERSIDE OF A CONCRETE SLAB

Impact may be as high as 7 times the static load on one rear wheel when a solid-tired truck strikes a 1-inch obstruction at 16 miles per hour, an average value being about 4 times. For pneumatic tires the maximum impact value is probably not more than 1¾ times the load at one rear wheel, and an average value is not more than 1¼ times the load.

All cushion wheels do not reduce impact on the road surface, even though they may cushion the vehicle.

These tests, of course, were run with artificial obstructions and depressions in the road surface, and the question naturally arises: Are actual road surfaces likely to produce any such impacts as indicated by this series? To answer this question, impacts have been measured by the use of an accelerometer mounted on the rear axle in a position to measure the vertical deceleration of the unsprung portion of the vehicle in striking the road surface. The path taken by the hub of a motor truck wheel in striking the surface and the manner of calculation of the impact pressure has already been indicated.

Tests were made by running different sizes of motor trucks over typical concrete roads and noting the maximum reading of the accelerometer. The unsprung and sprung weights of the vehicle and the acceleration as determined from the accelerometer being known, the impact pressures were then calculated, and it has been found that on typical concrete roads that have been in service up to four or five years considerable impact pressure can be developed. Tentatively, it can be stated that the maximum pressures to be expected under the rear wheels of the motor trucks are as follows:

2-ton	18,000	pounds
3-ton	24,000	"
5-ton	30,000	"

Additional tests are now under way which will throw more light on the accuracy of these figures. These pressures correspond reasonably well with the pressures found by the use of the copper cylinder measurements already mentioned, and correspond to heights of fall of the rear wheels well up to 2 inches, as determined in the old copper cylinder tests.

The Effect of Impact on the Stress in Concrete Roads

It would seem to follow that the higher the pressure created on a road surface, the higher should be the stresses created within the surface, and, in general, the more rapid should be the deterioration of the surface. Road materials differ very widely in their characteristics. Thus, concrete is perhaps the most elastic of the road surfaces in the sense that definite deformations are to be expected with definite increase in load. The bituminous surfaces behave more like a plastic material, the degree of plasticity changing with the temperature. Macadam, gravel and sand-clay follow the laws which govern masses of granular materials, and they possess elasticity and plasticity to a very limited degree.

The nature of the effect of the impact of traffic produced by roughness in these dif-

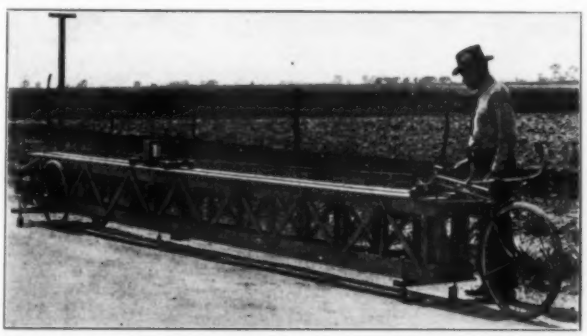


FIGURE 3. THE PROFILOMETER USED ON THE BATES EXPERIMENTAL ROAD IN ILLINOIS

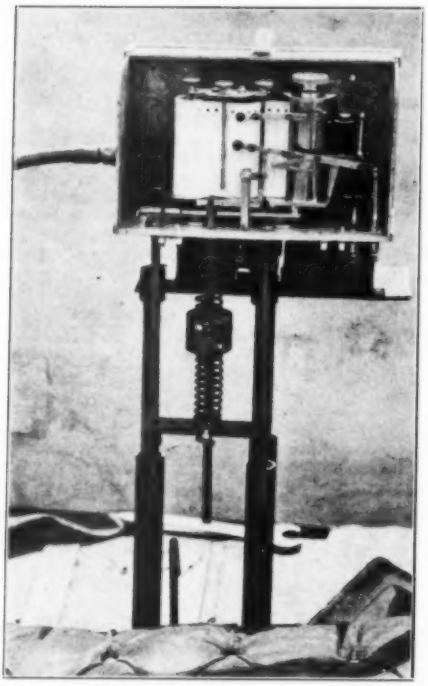


FIGURE 4. RECORDING ACCELEROMETER

ferent surfaces will therefore be different, depending upon the type of surface. Since concrete is of an elastic nature, it offers the possibility of making accurate measurements of stresses produced by traffic forces; the relative stress effect produced by different degrees of roughness can therefore be very accurately determined in a concrete road, and the stress produced furnishes a measure of the degree of destruction likely to result in the road surface.

Measurement of Fiber Stresses in Concrete Roads Produced by Impact of Motor Trucks

For measuring the stress or deformation in the road surface, recording strain gages were set along the edge and as close to the bottom of the slab as possible. A view of one of the instruments set in position on the underside of the slab is shown in Figure 2. Similar instruments were placed at the edges of pavement slabs 4, 6, 8 and 10 inches in thickness built for test purposes on several kinds of subgrade. A motor truck equipped with solid tires was then run at speeds of 2, 10, 15 and 20 miles per hour, with the center of the rear wheels 9 inches from the edges of the road. Over each position of the strain gage an obstruction was placed on the road, consisting of a metal plate 3 inches in width, with thicknesses of ⅛-, ¼-, ⅜- and ½-inch for the different conditions of operation of the motor truck.

These tests showed that for a given speed the stress always increases as the obstruction increases in height and, as might be expected, the effect is much more severe on the thinnest slabs. It is evident that the fiber deformations may be at least doubled when an obstruction of ½-inch occurs in a concrete road and the truck is caused to mount over that obstruction. Any condition which would make the truck wheel fall through the same distance would give very similar results. Apparently, for small roughnesses up to, say, ¼-inch, the increase in stress with speeds up to 15 miles per hour is quite small with all the thicknesses of slabs, but when the speed becomes higher than this, the stress curves show a rapid increase in stress as the speed increases. The ½-inch obstruction even at low speeds produces a very much higher stress than found in the smooth slab, and, moreover, the stress increases very rapidly with the speed.

In calculating stress it has been assumed that the modulus of elasticity of the concrete was 3,000,000, as determined in a static load test. It will be noted that the stresses obtained in this way in many cases exceed 700 or 800 pounds per square inch, the probable modulus of rupture of the concrete. The fact that no cracks are apparent in spite of this high stress needs more investigation to arrive at a satisfactory explanation.

According to investigations on the fatigue of concrete made at the Illinois State Highway Department laboratory, it seems that under repeated loads failure takes place under a comparatively few applications of loads producing a stress in excess of 50 per cent of the modulus of rupture. In the absence of more exact information on the relative stress at failure under impact and static loads, it would seem safest to accept half of the modulus of rupture as the safe unit stress produced dynamically as well as statically. If 800 pounds per square inch is the modulus of rupture of the concrete, the safe unit stress would then be 400 pounds per square inch; thus a 5,000-pound wheel load stressed the 4-inch slab beyond safe limits even when no artificial impact was produced. The 6-inch slab became unsafe with an ⅛-inch roughness at 20 miles per hour, and with a ¼-inch roughness at 10 miles per hour. The 8-inch slab began to receive an unsafe stress at 20 miles per hour with a ⅜-inch obstruction, and with a ½-inch obstruction at 10 miles per hour. The 10-inch slab was not overstressed with a ⅜-inch obstruction at 20 miles per hour, but with a ½-inch obstruction was overstressed at about 13 miles per hour. It is thus apparent that the deterorating effect of roughness is different, depending upon the thickness of the slab.

The effect of roughness on the deterioration of pavements of the bituminous type is a matter of common observation. Every one has observed the depressions formed in the best types of asphalt pavements on the far side of manhole covers in city streets. The slight impact of traffic results in the production of impact pressure which the pavement cannot resist

in its most plastic condition. Depressions in asphalt pavements resulting from any cause, whether from a local settlement, improper mixture or rolling, lead to impact with a resulting increasing roughness of the pavement and deterioration, whose progress will be rapid under heavy wheel loads and high temperatures.

The growth of washboard effects in gravel roads is known to be very rapid after a slight roughness once forms, and this growth may proceed from the formation of a single low spot which produces a succession of impacts of the vehicle wheels. Under average speed conditions the wheels land at approximately the same spots in the road, and on landing, the spinning wheels displace some of the road surfacing material, thus forming the waves with crests of loosely compacted gravel and troughs with material in a well-compacted condition. The higher the waves, the harder the impact becomes and the faster the surface deteriorates. All of the evidence then points to the desirability of not only producing a smooth surface initially, but by maintenance measures keeping that surface as smooth as possible.

Devices for Measuring the Roughness of Roads

Within the last few years several devices have been proposed for obtaining a measure of the roughness of roads. One of these devices, developed by the Bureau of Public Roads and assembled by the Illinois State Highway Department, is shown in Figure 3. It consists of a frame which may be set up on the road surface in the position desired and which then serves as a smooth trackway over which is run an auxiliary truck upon which is mounted an autographic device for recording the movement of a tracer wheel bearing on the road surface. The tracer wheel is drawn from one end of the frame to the other. The frame is then transferred to another position and the record thus obtained.

A similar device using the same kind of autographic recorder has been used in experiments conducted by the Iowa State Highway Department. Both of these devices record the absolute roughness of the road. Still another device used by the Bureau of Public Roads is shown in Figure 4. It is mounted on a frame connected with the axle of a motor truck. A weight suspended between an upper and a lower spring serves to produce vertical motion of the recording pen as the entire apparatus follows the vertical motion of the axle of the vehicle. The recording drum is moved by means of the speedometer cable. This same type of recording apparatus may also be mounted in the body of the vehicle, and the vertical motion of the axle with respect to the body is then readily transferred to the recording apparatus. This device may also be fitted with an auxiliary attachment for accumulating the vertical motion of the axle. When this device is used, it is necessary, of course, that the vehicle be run at a constant speed and that the tires and springs be kept under uniform conditions. The record obtained does not give an absolute measure of the roughness, but does give a relative measure of the roughness, and the record of the vertical motion accumulating attachment gives an index figure which is indicative of the relative roughness of the various types of roads. Such a device was built by the Bureau of Public Roads several years ago and has since independently been made available in commercial form.

In Figure 5 are shown typical records obtained with the instrument shown in Figure 4. A 5-ton truck equipped with new solid tires was used in the test runs. A profile of the road obtained by precise levels at 6-inch intervals is plotted at the bottom. Each peak in the records indicates an impact due to roughness, and the higher the peak, the greater has been the blow struck by the truck wheel. In general, note that:

(1) Even a seemingly smooth road surface will have appreciable roughness.

(2) The higher the speed, the greater and the more frequent will be the impacts delivered to the surface by the trucks.

(3) The rougher the road, the greater are the impacts, as shown by the increased height of peaks with ⅛-inch and ¼-inch obstructions.

ACKNOWLEDGMENT.—From a paper delivered before the American Road Builders' Association, at Chicago, Ill., January, 1924.

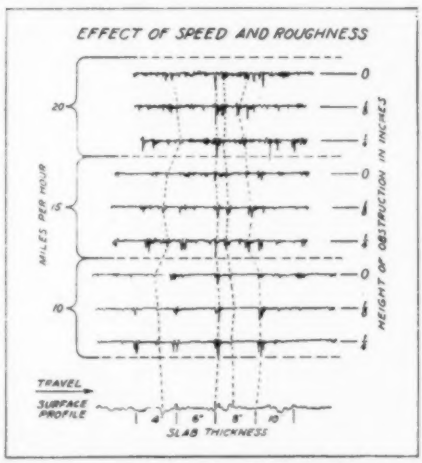


FIGURE 5. THE RECORD PRODUCED BY A RECORDING ACCELEROMETER

Jim's Remarks

WHEN the report of personal injury sustained by a teamster at the road construction camp came to the main office, it was turned over, as was customary, to the boss for his consideration. The blank form provided for reporting accidents was properly filled in as follows:

Nature of Accident—Toe crushed.

Name of Man—Jim Kelly.

How caused—Horse stepped on his foot.

Remarks—You know Jim. The sooner his remarks are forgotten the better for all concerned.—*Utah Highways.*

Winter Storage of Cement Helps Wisconsin Road Contractor

By C. R. Weymouth

Division Engineer, Wisconsin Highway Commission, Milwaukee, Wis.

IN the construction of a 10-mile section of State Trunk Highway 55 in Fond du Lac County, Wis., the Lampert Construction Company, of Oshkosh, Wis., handled the entire job from one set-up, at which the contractor installed a gravel-screening and washing plant and a central proportioning plant. These were located at a favorable point four miles from the northern end of the job. The road was built in four sections, the two sections on each side of the proportioning plant being placed first so that they could be used to haul over when the sections at either end of the job were built.

Preproportioned dry batches were hauled to the mixer in trucks equipped to carry two five-bag batches. Measured quantities of washed sand and pebbles were loaded into the trucks by means of steel storage bins and measuring boxes located near the aggregate - producing plant. Having received its load of sand and pebbles, the truck proceeded to the cement warehouse, where the proper amount of cement was added to the batch.

The cement warehouse was located at the side of the highway. Between the highway and the warehouse was a cement loading platform large enough to hold 300 sacks. This platform was separated from the warehouse by a depressed driveway used by the trucks when they received the cement content for the batches. Extending over the platform and over the driveway into the cement warehouse were two overhead conveyor tracks, upon which two ordinary manure carriers such as are used on farms were operated. Each carrier bucket held five bags of cement, and the conveyor tracks were so placed that the buckets could be placed over the driveway directly over the truck batch compartments. Usually the buckets were loaded from the cement platform, but when this supply was not replenished, they were pushed into the warehouse, and the required number of bags of cement were placed in the buckets. When the time came to use the cement in the warehouse only, the tracks for the conveyors were extended back into the shed.

During the first half of the job, three trucks were used to haul cement from Eden, 4 miles away, where the nearest railway siding was located. This cement was piled on the loading platform outside the warehouse and was used as fast as it was delivered. When shipments were delayed or when poor roads interfered with hauling, cement from the warehouse was used. At one side of the cement shed was a bag-cleaning and baling machine and a storage shed for empty sacks. One man was constantly employed in cleaning, baling and preparing empty sacks for return shipment to the cement mill.

The reserve stock of cement stored during the winter months was a boon to the contractor. It relieved him of the possibility of facing a shut-down due to non-delivery of this material during the time when both cement mills and railroads are taxed to the utmost to meet the summer demand for road-building materials. The state of Wisconsin has recognized this fact and has made provision for the winter storage of cement on its road contracts. The contractor bids on the road on the basis that the state will furnish the cement. Then he makes an auxiliary bid for hauling and handling all cement used on the job. A third bid covers the cost of storing a portion of the cement, usually from 35 to 50 per cent of the total amount to be used. This bid for cement storage includes the building of the shed and all storage, as well as tornado and fire insurance. In this manner both the state and the contractor are protected from loss.

Winter Storage an Insurance Against Delay

Availing itself of the privilege granted contractors on State Highway work in Wisconsin, the Lampert Construction Company, of Oshkosh, Wis., last winter stocked one-half of the cement needed for a 10-mile stretch of cement road, preceding actual construction. The cement was stored in a warehouse erected by the contractor near the site of his proposed central proportioning plant. During construction, the rest of the cement was received at the nearest railroad siding. The cement in the warehouse was held as a reserve and was used only on the last half of the job or when shipments were delayed. By thus insuring against delay due to a shortage of materials, the contractor was able to make steady, consistent progress toward the completion of his contract. An average daily run of 600 linear feet of 18-foot concrete, 7 inches thick at the edges and 8 inches at the center, was made with a 21-E paver.

ACKNOWLEDGMENT.—Published through the courtesy of the *Concrete Highway Magazine*.

Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt, consult your own lawyer

Edited by A. L. H. Street, Attorney-at-Law

Validity of Paving Improvement Proceedings

In the case of City of Valdosta vs. Harris, 119 Southeastern Reporter, 625, the Georgia Supreme Court lately ruled that a mayor was not disqualified to vote for award of a paving contract to a relative, under a statute providing for an award by the mayor and city council to the lowest and best bidder. It was further decided that paving improvement proceedings were not invalid because a resolution failed to describe the material with which it had been determined by a former resolution to pave the street, nor upon the ground that the resolution failed to state the "manner of construction," leaving that to the city engineer and the successful bidder.

Binding Effect of Engineer's Acceptance of Work

Where both a contractor and a supervising engineer are grossly mistaken as to materials and workmanship required under a contract, the engineer's acceptance of the work is not binding upon the owner, holds the Iowa Supreme Court in the recent case of F. E. Marsh & Company vs. Light and Power Company of St. Ansgar, 195 Northwestern Reporter, 754. The work involved was the construction of a dam and power-plant, and the contract specified that the engineer's approval of the work and acceptance of the same should be binding upon the parties. The Court said:

"It is the general rule that the acceptance and approval of a structure by an engineer appointed by agreement of the parties to inspect and pass upon same is conclusive upon the parties, in the absence of fraud or such gross mistake as would necessarily imply bad faith or a failure to exercise an honest judgment."

The Court holds that the evidence did not show actual fraud and collusion on the part of the engineer and the contractor, but that the evidence did show that both were guilty of gross mistake in the use of materials and in workmanship. The opinion also says:

The "designing and superintending engineer could not bind the 'owners' by approving and accepting the plant constructed of materially different and inferior materials and workmanship from that required by the contract." The "engineer had authority to hear disputes between the contractor and the owners or inspector of the work employed by the owners that might arise in the progress of the work as to whether or not materials called for by the specifications were being used, and whether or not the workmanship was of the quality called for by the contract. But the engineer had no authority to change the plans and specifications, and approve and accept inferior materials and workmanship." The Court approves a statement by a Missouri court that:

"The provision that the builder is to build according to directions of the architect should be construed to mean such directions as he may give looking to the completion of the work according to the plans and specifications, and not to mean that he may give [directions] for an improvement in a manner different from that provided in the plans and specifications."

Rights of Subcontractors and Material-Men as Lien Claimants

Speaking concerning the right of a materialman or subcontractor to enforce a lien against property on account of materials or work furnished to a general contractor, the New York Supreme Court for New York County said in the recent case of Kalt Lumber Company vs. Sterner, 201 New York Supplement, 567:

"As the plaintiff and the other lien claimants must claim through the general contractor, the Woodward Construction Company, Inc., a payment which was not due to it was not due to them. They are under the same obligation to prove performance and to the same extent that the general contractor would be. Their rights as lienors are measured by the rights of the general contractor under the contract.....A mechanic's lien depends for its validity upon the owner's indebtedness to the contractor, and the burden rests upon the lien claimant to prove the indebtedness. . . .

"The defendant owner in this case expended more money than the total amount of the original contract price plus the agreed price of the extras in order to complete the building. The settled construction of the Lien Law is that, except in the case of fraud (and none was proved here), the owner cannot, under any of its provisions, be compelled to pay any greater sum for the completion of a building than he has agreed to pay."

The Court further decided that where the owner of a building, after the general contractor abandoned the work, paid the workmen and paid for materials as they came in, he was protected as to all payments, at least up to the date notices of the filing of mechanics' liens were served on him.

When a Construction Contract Is "Substantially" Performed

In considering a question whether concrete work had been constructed in substantial compliance with contract requirements, the Iowa Supreme Court lately reaffirmed the following stated rule of law, in the case of F. E. Marsh & Company vs. Light & Power Company of St. Ansgar, 195 Northwestern Reporter, 754:

"'Substantial performance,' as defined by the cases, permits only such omissions or deviations from the contract as are inadvertent or unintentional, are not due to bad faith, do not impair the structure as a whole, are remediable without doing material damage to other parts of the building in tearing down and reconstructing, and may without injustice be compensated for by deductions from the contract price. So much is allowed in building contracts because of the hardship to the contractor if slight, unintentional deviations should bar his recovery."

The Court added that it was the duty of the contractor in this case, "at its peril, to use a concrete called for by the specifications."

Claim for Unexpected Expense in Constructing Foundation Denied

Before award of a contract to construct a dam, soundings were taken at the instance of the owner for the purpose of informing bidders where the foundation of the dam was to be laid; that is, how far it was down to bed-rock. When the dam came to be constructed it was found that bed-rock was some two feet deeper than the soundings disclosed. The contractor, in order to place the foundations upon bed-rock, had to excavate loose rock of about two feet in depth and use concrete, with reinforcing steel, in the lower two feet of the foundation, at considerable expense. Extra compensation on this account was claimed. Holding that the claim was properly disallowed, the Iowa Supreme Court said in the recent case of F. E. Marsh & Company vs. Light & Power Company of St. Ansgar, 195 Northwestern Reporter, 754:

"The specifications provided: 'The foundation for the new dam and power-house shall be graded down to solid rock, and bonded into same as indicated in the plans.'

"The specifications, or any other writing, did not specify the depth or location of 'solid rock.' The contract compelled" the contractor "to place the foundation of the dam on 'solid rock' or 'bed-rock', and it cannot recover for extra materials and labor expended in the construction of the dam on a lower foundation than it expected to find."

Contractor as Carrier of Passengers

Where a general contractor agrees to provide motor vehicle transportation for a subcontractor's employees from a railroad station to the place of work, he becomes bound to use the same high care in transporting such employees as is required of one engaged principally in the business of carrying passengers, holds the Connecticut Supreme Court of Errors in the recent case of Duffy vs. J. W. Bishop Company, 122 Atlantic Reporter, 121.

In this suit plaintiff demanded damages for injury sustained while being transported in an automobile which defendant operated in carrying plaintiff and other employees of the Jackson Stone Company, pursuant to agreement between defendant as principal contractor, and the Stone Company and pursuant to an agreement with plaintiff under which the Stone Company was bound to provide him with transportation. Passing upon defendant's appeal from a judgment in plaintiff's favor, the Supreme Court of Errors said:

"Appellant also maintains that it did all that it was required to do in the way of due care, in view of the duty owed to Duffy, who it claims was merely an invitee in the car. We cannot hold that this was his position. Under the facts found by the Court he was a passenger for hire, and the defendant was a private carrier, charged with all the duties pertaining to such a person. The contract of defendant with the Jackson Stone Company does not provide for the transportation of the latter's employees, but is concerned with matters of construction and the like. The contract of carriage was entirely separate from the building contract.

"Being a private carrier for hire, it was the duty of the defendant to exercise the usual skill, care, and diligence ordinarily exercised by those engaged in the same pursuit to furnish safe cars and appliances for transportation of these workmen and a proper driver of the car."

Engineers' Power to Decide Controversies Arising Under Contracts

Provision in a road improvement contract that the decision of the engineer as to the meaning of all specifications should be final, referred only to controversies between the contractor and the road improvement district concerning the specifications, and not to interpretation of the contract. It was so decided by the Arkansas Supreme Court in the case of Connelly vs. Parks, 255 Southwestern Reporter, 22. Speaking of the provision, the Court said:

"It has no reference whatever to the interpretation of the provisions of the contract, or of the specifications as a part thereof, in determining any issue that might arise between the contractor and the engineer as to the individual and personal duties and liability growing out of their respective contracts with the district."

The Court refers to the following observations made by it in a previous decision announced in a case involving a drainage improvement contract:

"There is a distinction between the power of the engineer with respect to interpretation of the plans and specifications and as to the contract itself. The former is supposed to be the work of the engineer, and it is proper in case of dispute to refer such interpretation to him, but, as before stated, the rights of the parties are fixed by the contract itself, and it is a question for the courts, and not for the engineer, to determine what those rights are."

Purpose and Progress of Equipment Standardization

By Clarence E. Bement

Vice-President and General Manager, Novo Engine Company, Lansing, Mich.

At a meeting of the officers and directors of The Associated General Contractors of America held in Detroit in November, 1922, a dozen or more manufacturers of contractors' machinery were called in with a view to the discussion of matters of mutual interest, and the bringing about of a better understanding of the problems with which both the contractors and the manufacturers were confronted. After an afternoon spent in discussion, two points were brought out prominently: First, there has been no attempt at standardization on the part of the manufacturers of certain classes of machinery where standardization is easily attainable. Secondly, in the matter of getting repair parts there has been a lack of uniformity in the method of ordering, especially from points remote from the main office, where repair lists are not always kept. There has been delay arising from questions of credit, and manufacturers have been lax in publishing repair price lists with clearly defined cuts and a definite nomenclature common to this particular class of machinery, and, most important of all, in filling repair orders with the least possible delay.

It was finally decided to appoint a Joint Committee on Construction Equipment, composed of seven representatives of the manufacturers and seven representatives of the contractors, a representative of the American Society of Mechanical Engineers, and later on a representative of the American Concrete Institute. These, with R. C. Marshall, Jr., General Manager of the Associated General Contractors, and W. P. Christie, Secretary of the same organization, made up the formal body. As much as possible, however, the meetings of the Committee have been informal, and all those with a vital interest in the problems presented have been called in.

Concrete Mixer Standardization

The first meeting of the Joint Committee was held in Chicago in January, 1923, the result of the discussion there being that in the following May a sub-committee of the Joint Committee met with a committee of five concrete mixer manufacturers and a tentative program was laid out for a meeting of the Joint Committee to be held in Chicago, June 27 to 29, to discuss the standardization of concrete mixers. This meeting lasted for three days and was attended, in addition to the Joint Committee, by representatives of the larger mixer manufacturers, and of the Western Society of Engineers, the American Society of Civil Engineers, and the U. S. Bureau of Public Roads, the American Society of Mechanical Engineers being represented on the Joint Committee.

It developed early in the discussion that the non-tilting and paving mixers formed a class so radically different from the tilting type that it was decided to hold a separate meeting the third week in July to take up the standardization of the latter class. The discussion was carried on under some thirteen heads covering most of the points capable of standardization. There was a spirit of "give and take" shown on the part of the manufacturers that betokened well for the success of the movement. It is true no radical steps were taken and no vital changes made in the present product, but certain fundamentals were agreed to that, if properly followed up, will go far toward simplifying and standardizing this class of machinery.

Standards of measurements were adopted, being the cubic foot and the United States standard gallon. The rating of boilers is to be the A. S. M. E. h.p. rating; steam and gas engine rating to be referred to the same authority, and the rating of motors to the American Institute of Electrical Engineers. The mixer rating and drum capacity was not agreed to, although it was the consensus of opinion that the water capacity of the drum when stationary was the rating basis, the maximum operating grade to be used in the rating of pavers being 8 per cent. A standard table of mixed aggregates was adopted.

Perhaps the most important action taken was the adoption of standard sizes for paving and building mixers. The paving mixers are to be of three sizes—7-E, 12 or 13-E (to be decided by referendum of the Associated General Contractors), and 21-E. Six sizes of building mixers are to be standard rig—3½-S, 5-S, 7-S, 14-S, 21-S and 28-S. The A. S. M. E. standards for shafts, keys, keyways and gears were recommended though not adopted. A standard nomenclature was recommended, that of the Concrete Mixer Association being used as the basis. A standard name-plate was adopted, permission to use it being granted to the manufacturers on their conforming to the standard requirements of the A. G. C. The tilting mixer manufacturers met on July 30 and adopted practically the same standards as the non-tilting mixer manufacturers, modified as applied to their particular type of mixers. The recommendation of the manufacturers as to the sizes of the tilting mixer was that two sizes under the 7-S size be made standard, namely, 5 cubic feet, and 3½ cubic feet.

Wheelbarrow Standardization

In connection with the discussion of standardization of concrete mixers, the subject of wheelbarrow standardization was taken up and a report made on this subject by H. H. Baker.

Under this report, which was accepted by the Committee, wheelbarrows are divided into four classes as regards their trays, with capacities running from 2 cubic feet to 3½ cubic feet. There seems to be a fairly unanimous agreement on the part of the wheelbarrow manufacturers as to the classification in regard to capacity of trays and the gage of the material that shall enter into the different sizes. In this same report three types of handles were suggested, covering those made by most, if not all, of the wheelbarrow manufacturers. A standard leg is also shown, which, however, is subject to the variation of the various manufacturers.

The result of the wheelbarrow classification will be to cut down the sizes, keeping them as nearly as possible to the number adopted during the war, at which time a good many sizes were eliminated, to the profit of all concerned. The same condition will apply to wheelbarrow standardization as to the standardization of concrete mixers, namely, that this standardization will not produce interchangeability, even in the matter of trays; as, although the capacity may be the same, the form will ordinarily vary among different manufacturers. The real accomplishment will be the reducing of sizes, the agreement on capacity and gage of tray, and general uniformity in construction, as regards wheelbarrows manufactured for different classes of work. While further standardization may take place in the development of this work, there is the natural desire of the manufacturer to maintain his individuality and cultivate talking points in which he feels that he is superior to his competitor.

Results of First Investigations

As will be evident, the really vital accomplishment of this first investigation of the Joint Committee on Construction Equipment is the agreement on sizes and the adoption of standards of measurement of capacity. Standardization in the case of cement mixers and wheelbarrows will not mean interchangeability of parts between different manufacturers; such a result is not attainable, and may not be desirable, but certain standards have been and will be set up that will force the manufacturer to build his machine up to an agreed standard of capacity and efficiency, and bring standardization in those parts and operations which are common to all mechanical equipment. The interchange of ideas brought about by the discussion of the disputed questions is one of the by-products of this investigation which will clarify the mechanical atmosphere and eliminate a certain amount of mistaken mechanical ideas, all in the interest of simplification and standardization.

We must recognize the fact that the manufacturer, in his natural and proper selfishness, is not going to give up any of the things that are peculiar to his own product and that he believes make it superior to his competitor's. Neither is he going to make it easy to duplicate his machine or the repairs that are naturally called for. In the standardization of automobile parts it has been found impossible to carry this work beyond the point at which the proper selfishness of the individual manufacturer was affected by making his product so uniform that parts could easily be duplicated by others than himself. The story that comes out of Germany, that in the manufacture of locomotives different manufacturers have been able to divide up large orders between the various institutions and provide parts that were absolute duplicates, is not a program that will appeal to the average American manufacturer. Simplification of parts, elimination of unnecessary sizes by agreement between the different parties involved, adoption of standards of measurements that are common to all, adoption of standards set up by the various societies as regards the quality of material, standards of threads, gears, etc., these are the things that can be brought about with a fair degree of unity, and with a reasonable amount of cooperation, and will furnish the foundation for carrying on this work.

It must be remembered that no undertaking of this kind can make an impressive showing within a short time, but is a matter of continuing pressure and the maintenance of an organization that will keep everlastingly at it.

Valuable Compilation of Building Costs

The Valuation Committee of the Southern California Chapter of the Associated General Contractors, composed of J. C. Bannister, P. M. Jones, and Paul B. Davidson, have recently completed a compilation of present average building costs in Southern California. The information in this compilation will be used by the County Assessor as an aid in determining the correct valuation of buildings. It will be used by the mortgage and loan departments of many local banking institutions.

Class A steel frame buildings—cost per cubic foot: office buildings, 53 cents; hotels, 58 cents; lofts, 28 cents; warehouses, 25 cents.

Class A reinforced concrete buildings—cost per cubic foot: office buildings, 50 cents; hotels, 55 cents; lofts, 25 cents; warehouses, 20 cents.

Class C brick buildings—cost per cubic foot: stores or theaters on ground, rooms, apartments, etc., above, 33 cents; apartments, 38 cents; lofts, 20 cents; warehouses, 15 cents. One-story garages, per square foot, $1.75; one-story stores, per square foot, $2.25.

Frame buildings—cost per square foot: California houses, good, $3; medium, $2.50; cheap, $1.75. Bungalows, special, $5 to $6; good, $3.60; medium, $3; cheap, $2.50. Bungalows, out of town (no restrictions), good, $3.75; medium, $2.75; cheap, $2. Residences, two-story, good, $6 to $8; medium, $4.50; cheap, $3. Outbuildings, good, $2 to $2.50; medium, $1.70; cheap, $1. Corrugated-iron buildings, all kinds, approximately $1.

How Buildings Acted in the Japan Quake

Eye-Witness Describes Destruction and Tells Why Some Buildings of American Design Continued to Stand

By Stanley E. Stady

THE prevalence of earth tremors in Japan for many ages has stimulated the Japanese to be the first in the scientific study of their causes and reactions. On the average, four tremors a day are registered throughout Japan. Following the San Francisco disaster, Professor Omori came to this country and made a careful study of the results of the quake on our large modern buildings. His recommendations were largely followed in the construction of big buildings in Japan.

He discovered that the average tall structure had an oscillation point in response to the earth tremors at about one-third of its height from the base. This I can vouch for as demonstrated in the last quake, when I saw Tokyo Kaikwan, a modern five-story reinforced concrete structure, in action. The terrific swaying a distance of over 15 feet from side to side, followed by a rotary motion, used the second floor as an axis until both outside and inner walls were completely ground out.

Perhaps my own observations during that eventful day of September 1 can best describe just how everything acted. Without warning of any kind, the combined forces of nature assembled about Tokyo and Yokohama for convincing demonstration of their superiority over man and man-made things. The earthquake shook down, the tidal wave rushed in, and a cyclonic wind drove an all-devouring wall of fire across this area, completely destroying the remaining life and material.

Mr. Stady, whose account of the Japanese earthquake is presented here, explains why some buildings of American construction withstood the terrific shocks of September 1, 1923, how they acted during the tremors and what is essential in design if construction is to be measurably earthquake-proof. Mr. Stady was Advertising Manager of the Tokio Advertiser at that time and was in a room with a friend when the quake began. His story describes the tremors and the immediate reaction of furniture, buildings and the ground itself. We are indebted to The American Contractor for the opportunity to print this remarkable story.

Both fate and fortune found me in the heart of Tokyo's big-building district when everything began to happen at noon on Saturday, September 1. I was on my way to a bank to cash a check and had just stopped for a few moments in the office of a friend when the cataclysm broke loose. The floor began to rock like a small boat in a rough sea, plaster was falling and pictures swung madly on the wall, a large table was being shuttlecocked around the room, a suspended fan swung until it dug holes in the ceiling, a massive bookcase just back of me flopped on the floor in front of me. During all this and for the next five minutes of the major quake there was a dull, rumbling noise coming from below, above and all sides, punctuated with sharp creaks, booms, and crashes as buildings swayed and collapsed.

By this time I knew well it was one of the worst earthquakes of the fifty or more that I had experienced during a year's stay in Japan. I grabbed my hat and hurdled through a window, dropping about 15 feet to the ground, and backed away just in time to escape an avalanche of brick and tile, dislocated from the top of the building. I turned to escape to my left, and there I saw in mid-air a scaffolding bearing six workmen being catapulted from the top of a four-story building. I dodged the splash of this débris as cracks were appearing in the street, which was rolling in waves like water.

My friend had escaped from the building in safety, and with our hands on each other's shoulders we stood braced that we might have four legs to stand on and four eyes to see in all directions. The vibration of this first tremor was so great that all about us we could see people being knocked to the pavement, cut down and covered up by scattering débris raining like bursting shrapnel. The fronts of the buildings were being bowed in and out like sails in a strong wind.

Looking down this narrow canyon of a street, I could see Tokyo's biggest building swaying like huge masses of jelly. Loosened brick and terra cotta were falling to the street like leaves blown from a tree in the autumn. It was almost inconceivable to see and difficult to realize that such apparently massive buildings could behave in that manner.

Although we saw hundreds being killed and the whole world going crazy, it was a sight far past ordinary fear. It had become fascinating and hypnotizing. At this time I saw the Tokyo Kaikwan in action, while two blocks away the tops of the new Marunouchi Building and the Nippon Yusen Kaisha office were trying to bridge the distance across the narrow street as they swayed from side to side. But the remarkable fact remained that these buildings, as well as practically all the reinforced steel structures, did not fall or collapse.

The Marunouchi Building, built by the Fuller

Construction Company, and completed for occupancy this last year, was of reinforced concrete with brick and stone facing and seven stories in height. It was the largest building in all Japan. The outside wall between the windows of the second and third floor showed perfect X-like cracks due to the rotary motion, and some plaster was loosened and the marble slabs in the hallways damaged; but it is little wonder. No one was killed, however, and very few windows were broken. It now stands and is in use as a most important center of business activity, a monument to American construction.

Another building worthy of comment is the Mitsui Bank, built on Roman lines with construction of massive pieces of granite, which showed not a crack nor a sign of the quake. The Mitsukoshi department store, five stories high, built about ten years ago on quake-resisting principles, did not collapse, and though it was burned inside and out, it is now refitted and serving as a most important base for the distribution of supplies.

The New Imperial Hotel is another striking example of American design and construction. It has been subject to more than the usual share of criticisms from fellow architects and tourist-laymen alike: "The man who built this crazy house was a nut." "How weirdly beautiful, but impractical; it looks like a child's house made of blocks." "This will be the first thing to tumble down when a real earthquake comes." Such has been the comment hurled at the head of Mr. Wright, an American architect from Chicago, who designed the new Imperial Hotel in Tokyo. It had just been completed for use during the past year at a cost of $4,000,000.

My friend, after the thrilling moments of the first quake, thought only of his wife and child in the Imperial Hotel, which he, being influenced by the comment he had so often heard, thought would be one mass of ruins. His surprise was as complete as his happiness to find, on his return, that the hotel had weathered the great tremor with no apparent damage.

Behind the front of a truly fascinating design, most efficiently laid out, Mr. Wright had built better than his army of critics could foretell. This pile of stones, this wild dream of an American architect, had met the test and stood better than any other building of its size in Tokyo. With the exception of the overturning of two stone pillars that had stood on either side of the lily pond in front of the hotel, three small cracks in the wall of the left wing, and a pillar of an outside pavilion in the rear undermined, there was no real damage—not a win-

TYPICAL RESULT OF RECENT JAPANESE EARTHQUAKE ON MODERATE-HEIGHT BUILDINGS

This illustration, furnished through the courtesy of The American Contractor, depicts the Tokyo Kaikwan after the earthquake, showing how the second floor was ground out because of the shaking and the rotating of the building. Japanese investigation at the time of the San Francisco disaster had established that buildings tend to rotate around an axis at about one-third of the height of the structure

dow broken, not a roof tile missing—nor could any serious weakening of the vital structure be seen.

The main reason why the building met this extreme test so successfully was that it was not top-heavy; and was well constructed on a secure foundation. The quake showed no partiality, however, as the water in the lily pond was lashed into waves about 6 feet high, and nearly all the dishes in the kitchen were broken.

During the next ten days 1,200 additional tremors of varying intensity were registered, which made it most dangerous to be anywhere near the many buildings already badly weakened. Although much has already been said on the qualities of ferro-concrete structures in withstanding the quake, it does not mean that every steel or reinforced concrete building successfully met the test. Whereas many might have been used soon after the quake, there were few indeed fit for anything but dynamiting after that all-devastating wall of flame swept over the city.

The question of how to construct a building as nearly quake-proof as possible is a problem not yet completely answered, for it can be seen from the description of this great disturbance that the forces of nature are greater than the things man can make. However, much can be done to advance more quake-proof construction.

It was discovered that buildings on loose, alluvial, or reclaimed land suffered worse from the shock, whereas structures on solid or rock foundations were not damaged so badly. The factors of limited height, walls thicker at the base than at the top, steel vital structure, and scientific attention to reduce possible stresses, strains, and torque when the building sways from earth tremors are all extremely important; but an even greater factor is that of a solid and perfect foundation.

Think, for a moment, of the crust of the earth being like the surface of the ocean, as it really becomes during violent earthquakes. Imagine a pontoon bridge or a number of small boats tied to each other as being much like a large building on a poor foundation in soft soil. You can then appreciate how such a building will be torn and wrenched, pitched and tossed about like a pontoon bridge in a rough sea. The pontoon bridge, like the building with a poor foundation, will experience uneven strains sufficient to pull it apart and cause its collapse.

The logical development of this idea is to place such a solid foundation, or such a thick bed of reinforced concrete, under a large building that when it is pitched and tossed about by violent earth tremors it will ride this rough sea like a big boat, a complete unit, floating on its concrete bed foundation. Even though massive trans-Atlantic ships roll and pitch and toss in a heavy sea, they do not collapse and fall apart, because the whole boat responds as one unit. So would it be with a big building floating on its bed of concrete in a rough sea of earth tremors.

Is Engineering a Profession or a Business?

It Does Not Seem Practical to Establish a Purely Professional Code of Ethics That Will Procure Uniform Observance

IN a recent very interesting address before the Toronto Branch, Engineering Institute of Canada, Professor C. R. Young, of the University of Toronto, made the rather significant statement that the present status of engineering is part profession and part business. He stated that it is very difficult under existing conditions to frame a comprehensive code of ethics for engineers, and concluded that it does not seem practicable to establish a purely professional code of ethics that will procure uniform observance by the engineers of the country. Mr. Young said:

"The method of solicitation of new work in engineering is by no means in conformity with those observed by the leaders of law and medicine. The intensive canvassing and lobbying which characterize the conduct of some engineers in the consulting field at the present time do not well compare with the high ethics of Smeaton and Telford. They are of one and the same type as the methods employed to secure orders for bacon or boots.

"The competition that is sometimes introduced by engineers with others who have to all intents and purposes secured a given piece of work is not that characteristic of a pure profession. Thus, when the plans of an engineer have been accepted and tenders are called thereupon, it may be questioned as to whether alternative plans are properly tolerable without the full prior knowledge and consent of the client's engineer. It is, of course, a common procedure for engineering contractors to submit their own designs in competition with those of the engineer in charge of the work, and that practise is so firmly established that it is not likely to be given up. In essence, it is an embarrassing procedure. It, in effect, proclaims that the client's engineer has insufficiently studied the situation and that he has overlooked the merits of another scheme which might prove cheaper than the one which he has recommended. Anything which lessens the confidence of the client in his engineer's complete mastery of the subject may well be considered as questionable ethically, but so far have we departed from pure ethics in the practise of engineering that this procedure often excites no comment.

"Under such conditions it becomes very difficult to frame a comprehensive code of ethics for engineers. When they are operating in part as professional men and in part as men of business, it does not seem practicable to establish a purely professional code of ethics that will procure uniform observance by the engineers of the country."

Cheap Power for Road Machinery

Tractors Greatly Reduce the Cost of Building and Maintaining Streets and Highways

THE big highway problem is the cost of the construction and maintenance of the roads. For this reason, highway and street officials, as well as road contractors, are investigating more and more the value of tractors in handling road-grading machinery, maintenance equipment and snow-removal equipment. For the straight hauling of elevating graders, blade graders and large drags, the tractor is unsurpassed, and when it comes to keeping roads open in winter, tractors are supreme in handling pusher plows, V-type plows and the new rotary plows which have been developed.

The Bear tractor, made by Bear Tractors, Inc., 53 Park Place, New York City, has come rapidly to the fore in the tractor world because of its fine automotive engineering and quality of construction and operation. This machine is not only adaptable to summer work and snow removal, but is being used every day in the year where all kinds of road and contracting jobs are under way. The tractor is equipped with a 4-cylinder engine, and is cooled with a direct sectional radiator and a gear-driven fan delivering 9,000 cubic feet of air per minute over the surface of the engine. The track, which gives traction in all kinds of going, is a drop-forged continuous-tread track which runs dry, with each unit easily detachable. The tread wheels, both front and back, are 36⅝ inches in diameter. The length of tread is 64 inches on the ground and it is 12 inches wide, giving an area of 1,536 square inches of tread surface on the ground and a ground pressure of 3½ to 3.9 pounds per square inch.

A BEAR TRACTOR HANDLING A ROAD-GRADING JOB IN TULSA COUNTY, OKLA.

The turning radius of this machine, which weigs 6,600 pounds when completely loaded with fuel oil and water, is 6 feet, and it operates at 5.9, 3.4 and 2.1 miles per hour forward and 2 miles per hour in reverse.

The Traveling Salesman

The wide-awake, progressive contractor who is looking for new ideas is always glad to meet salesmen for building-supply firms and for contractors' equipment. While they take a little of the contractor's time, they are as a class wide-awake and observant, and because they spend their entire time talking to contractors, architects or engineers, they pick up a good many valuable ideas which they are always ready to pass along. Ten minutes' talk with a salesman for such a firm may result in getting suggestions and information worth a great deal of money to the contractor.

Data on Spray Painting for Building Contractors

This Machine Has Materially Cut Painting Costs in Many Fields

THE development of the spray machine for paint and varnish application was due primarily to the great demand placed upon the painting industry by war-time activities and the absolute necessity for increasing the available means for paint application. The shortage of men capable of wielding brushes soon became apparent, and the great speed demanded in production became a vital factor. The success of spray painting war equipment has paved the way for its use in peace-time practise, and the satisfactory results obtained by many firms with the use of the spray machine have clearly demonstrated its practicability, economy and value for up-keep painting.

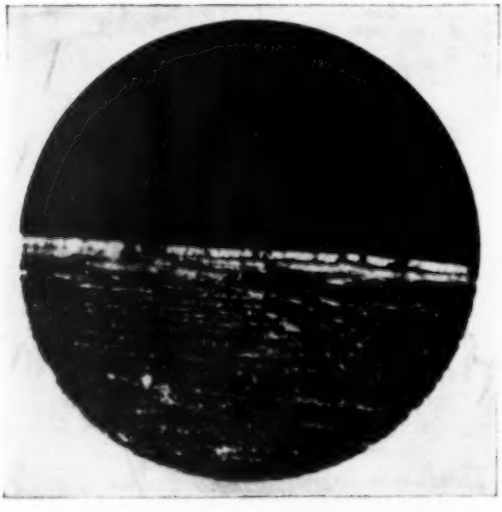
SPRAY-PAINTING A WIRE FENCE, SHOWING EQUIPMENT AND SHIELDS

Spray-painting equipment for up-keep work comprises two units: one, the air compressing unit, consisting of an air compressor, air receiver, motive power and accessories, supplied in both portable and stationary types; the other, the spraying unit, consisting of one or more paint guns, material containers, regulating and air cleansing means, hose and other accessories.

The power used for running the compressor may be secured from an electric motor, gas engine, steam engine or line shaft. The air receiver is employed to store the compressed air and to prevent pulsation in the air line. Each air receiver is equipped with pressure gage, adjustable safety valve and main valve. From the air receiver the compressed air is piped to the points where the paint gun is being used. The portable type of air compressor, which is used most in the construction field by contractors, is mounted on a wheel-base, and the drive is either motor or gas engine.

Paint guns are of two general types—the attached cup or jar type, and the separate container type. The former is used mainly for spraying manufactured articles in a fixed booth and is not recommended for general painting purposes. The latter type is employed for industrial painting in general. It has both fluid and air lines leading to it. The paint or other material is in a separate container and is forced to the paint gun through the fluid hose by gravity or air pressure. The air for atomizing the paint and shaping the spray is led directly through the air hose. Both the flow of the air and the paint can be adjusted so as to control the amount of material applied and the degree of atomization employed.

The material container for use with the separate container type of paint gun ranges from 1 to 50 gallons capacity, and may be either of

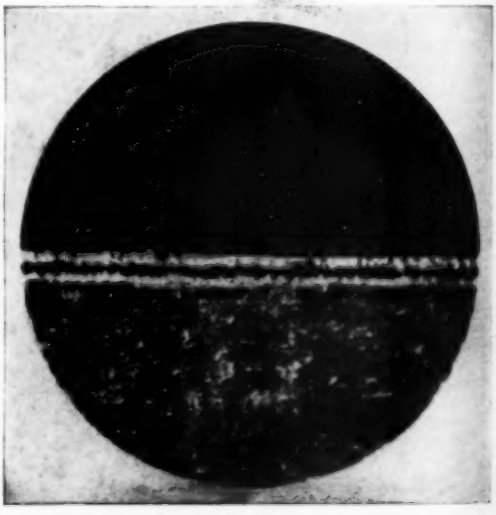


PHOTOMICROGRAPH OF CROSS-SECTION OF WOOD COATED WITH HAND BRUSH, FIRST COAT WHITE, SECOND COAT RED, THIRD COAT WHITE

two types. The gravity type is used exclusively for stationary service in situations where the article to be coated is brought to a booth supplied with exhausting equipment for taking off excess vapors. It is mainly used for finishing manufactured products. The pressure type material container consists of a suitably constructed tank easily accessible for cleaning. This container has either a screw type or a bolted-on head, and is fitted with a diaphragm type regulator, which controls the amount of air pressure used to drive the material through the fluid hose, also the air employed for atomizing purposes. The container is equipped with an air or a mechanical agitator for preserving the mix of the material.

Regulation of the air pressure serves to form the spray into different shapes suitable for quickly covering the work. An important factor attendant upon the success of spray painting is the correct regulation of the air pressure and the flow of the material. Too great an atomization pressure causes waste and over-aeration of the material that is being applied. This is frequently the cause of a defective finish. To take care of this condition, air-purifying, straining and regulating devices are employed. The proper amount of air pressure to use in connection with spray painting is very hard to determine, owing to the fact that various materials require a variation of air pressure, and no set rule can be given. Just enough air pressure should be used to cause the paint to flow freely through the holes to the spraying machine. When working on the ground, a pressure of from 5 to 10 pounds will be found sufficient to force the average material through the hose, and from 35 to 45 pounds pressure to atomize the paint at the nozzle.

Too much air pressure on the paint will force more material through the nozzle than can be properly atomized, which results in sags and unnecessary weight in material. As to the proper distance to hold the machine from the surface to be coated, this has been found to be from 6 to 8 inches. The thickness of the coats of paint applied can be varied at the will of the operator. As in all painting, the inexperienced spray operator has a tendency to apply a heavy coat, and it is necessary for him to use extreme precaution and see that the adjusting needle valve on the spray is constantly kept tight and to allow only enough air pressure on the paint to cause the paint to flow freely at the nozzle. It is just as necessary to have a variety of sprays and nozzles for different kinds of work if the proper results are to be obtained as it is to have different styles and sizes of brushes. The equipment of nozzles and sprays, as given by the following code, is



PHOTOMICROGRAPH OF SECTION OF WOOD COATED WITH SPRAY GUN IN SAME SEQUENCE AS SAMPLE ABOVE

the same for any make of spray machine: for the application of ready-mixed paint, J—large spray; K—small spray; A—size of nozzle in diameter, 3/16-inch; D—.081-inch; E—.070-inch; F—.0465-inch; FF—.055-inch.

The most important things to observe in the application of ready-mixed paint are the size of the nozzle, the paint and the atomization pressure, and also the size of the air compressor. The average spray requires approximately 6 cubic feet of air per minute. Any compressor which has a cylinder smaller than 3½ x 3½ inches will not give a sufficient amount of air for spraying. Strain all material before spraying. An atomization pressure of from 45 to 50 pounds should be used on the priming coat, and 50 to 60 pounds on the finishing coat. The J spray with an E nozzle is recommended for the priming coat, and K spray with an F nozzle for the second coat.

Effect of Surface Conditions

Surface conditions present certain problems which require very careful consideration. If a surface is very badly weatherbeaten and the cracks are extremely large, it is almost impossible to fill them with the spray alone, but by using a spray and a brush together and applying the primer with the machine and then working the brush over rapidly, all weatherbeaten cracks can be perfectly filled, and the process requires but a very few minutes extra.

In preparing ready-mixed paints for priming work, reduce with a mixture of raw linseed oil and turpentine two to three pints to the gallon of paint, varying the relative amounts of the two liquids to meet the requirements of the surface. Do not use too much oil in the priming coat, as this will cause it to dry with too hard a gloss. It is absolutely necessary that the priming coat be flat and that no gloss spots appear before the second coat is applied. During the early spring and fall, paint has a natural tendency to "crawl" where any gloss spots are showing. These are easily taken care of if the second coat is brushed, but with a paint spray we encounter more difficulties, and that is one reason that the priming coat should be strictly flat. If the case is one where there is considerable gloss showing in the priming coat, and the spray operator is having difficulty in keeping the paint from crawling, he may overcome this trouble by spraying a very thin coat of turpentine or benzine over the gloss surface; or, if this will not stop the trouble, a damp cloth rubbed over the gloss spots will do the trick. He will then be able to apply the second or finishing coat perfectly.

The second coat should be applied as the paint comes from the container. A very thin coat is used. An extra heavy coat will cause crinkling, with the result that it will have to be burnt off in a very short time. Two thin coats are better than one thick one. Naturally, however, in using a spray it is advisable to produce the desired result with the application of as few coats as possible. On inside painting, one spray coat of flat white is equal to two brush coats. Because of a greater uniformity with the spray method of application, the freedom from alternate thinness and thickness in a coating, and the greater surety of getting the paint into ordinarily inaccessible or difficult places, the spray job will generally prove more satisfactory for general industrial purposes than brush work.

A COMPACT SPRAY PAINTING OUTFIT

Extreme precaution should be taken in using ordinary garden hose for paint hose. Paint passing through this class of hose continuously will cause it to deteriorate in a short time. Small chunks of the rubber from the hose will cause the nozzle to become clogged, and much time is lost when the spray has to be cleaned out every hour. Nothing but a hose specially built for spray painting should be used.

Cleaning the spray equipment after the day's work is finished is of utmost importance. Much trouble with spray machines may come from neglect to observe this precaution. The proper way to clean the equipment is to blow all paint out of the paint line and tanks and then run half a gallon of kerosene through them. The spray gun should be disconnected from the paint hose and left in kerosene over night.

Diversity of Use of Spray Painting

There seems to be no limit to the practical application of spray painting in building work. Walls, ceilings, floors, beams, interior and exterior surfaces may be successfully treated in this manner. Even woven-wire factory fencing can be spray painted with satisfaction. In painting fencing, two men operate the equipment —one with the gun and the other on the inside of the fence to move the shield and touch up the supporting pipes. By being applied against

the shield at an angle of 45 degrees, the paint rebounds and paints both sides of the wire at the same time. It is understood that 20 sections of fence 10 x 7, including the barbed wire above, can be painted in one 8-hour day by two men, including setting up and cleaning the equipment. The entire cost in each instance, including paint and labor, figured 0.75 cents per square foot of fence.

In spraying interior flat paint on one practical painting job, six men (two operators, two men to strain paint, and two men to move scaffolding) applied in two days sufficient flat interior paint to cover 58,000 square feet of surface. The cost of application, not including the cost of paint, figured about $0.0013 per square foot of surface.

The use of a spray gun for applying two different types of metal paints has proved very efficient. In painting an area of 2,208 square feet, one man required 16 hours and used 7½ gallons of paint by hand, while with the spray machine, one man required 1.86 hours and used only 6 gallons of paint, when red lead paint was used. On another job, using red oxide paint, one man, using a hand brush, required 150 minutes and 2½ gallons of paint to cover a surface area of 1,170 square feet. With the spray machine, the same surface was covered by one man in 16 minutes, using 1¾ gallons of paint.

Uniform Composition of Sprayed Paint

One manufacturer of spray guns has made an interesting experiment to show the constancy of composition of paint as it leaves the nozzle of the gun. In a test with a certain paint containing a rapidly settling pigment, the machine with air agitation was stopped at frequent periods, and samples were taken from the nozzle. Three different paints were used in each test, making nine samples in all. Analysis of the paint showed a variation between pigment and vehicle of an approximate average of 1/10 of 1 per cent. Similar samples taken from the brush operator showed a variation of slightly more than 19 per cent in some cases.

Advantages of Spray Painting

In considering the spray method of painting, three things must be given attention—durability, cost of application, and cost of paint. Experiments have shown that a well-designed paint, properly prepared for spray application, will penetrate the pores, and that, aided by the impact of the paint striking the surface, a better bond and a more uniform coating are secured than when the brush is used.

The nature of the surface to be coated, as well as its accessibility, must be considered. For hand brush work a building must be laddered or scaffolded so that the painter can come within arm's length of his work. The setting and placing of ladders and scaffolds represent a large portion of the expense of some jobs. In spray painting a large amount of the scaffolding is eliminated, as the operator does not have to work so close to the surface, and by the employment of an extension sprayer he can cover a surface 10 to 15 feet distant. The width of the average paint brush stroke employed in applying paint to a building is 3 to 4 inches, and to cover the surface at least two passes across the work are necessary. The average width of the spray stroke is 10 inches, and the flow of paint is regulated so that only one pass across the work is necessary. Recently, spray guns have been put on the market that project a flat, fan-type spray from 28 to 30 inches wide. With these spray guns large surfaces can quickly be given a fine uniform coating. From a surface coating standpoint, a spray gun will do the work of from two to ten men using hand brushes, the amount varying with the character of the work done.

Investment

It is difficult to give definitely the investment necessary to make the purchase of a complete spray painting outfit. The type, capacity and amount of equipment required regulate the price. As an approximate figuring basis, they range in price from $300 to $500 for portable equipment. When considering the purchase of spray-painting equipment, it is best not to guess on what is required. Place your needs in the hands of reliable manufacturers and let them supply and guarantee the particular equipment best suited to your needs. In the very helpful book, "Principles and Practices of Upkeep Painting," prepared and published by the Paint and Varnish Division, E. I. Du Pont de Nemours & Company, Inc., 35th Street and Grays Ferry Road, Philadelphia, Pa., from which this article is prepared, the following makers of spray machines of proved quality are listed: Spray Engineering Company, 60 High Street, Boston, Mass.; the DeVilbiss Manufacturing Company, 3734 Detroit Avenue, Toledo, Ohio; Paasche Air Brush Company, 1915 Diversey Parkway, Chicago, Ill.; Dayton Air Brush Company, Dayton, Ohio; C. N. Matthews Company, St. Louis, Mo.; and the Eclipse Air Brush Company, Newark, N. J. It is further stated that Bauer & Black, Chicago, Ill., are the makers of a successful type of mask to protect spray painters.

Are We Substituting the Means for the End?

Industrialized communities neglect the very objects for which it is worth while to acquire riches, in their feverish preoccupation with the means by which riches can be acquired.—*R. H. Tawney.*

Miscellaneous Notes

Miller Is New Huber Sales Director

THE Huber Manufacturing Company, Marion, Ohio, has announced the appointment of M. E. Miller as Sales Director for the company. Mr. Miller was formerly General Sales Manager for the Aultman-Taylor Machinery Company, Mansfield, Ohio.

New Dayton-Dowd Sales Offices

THE Dayton-Dowd Company, Quincy, Ill., manufacturers of centrifugal pumps, have announced the opening of consolidated sales offices at 30 North Michigan Avenue, Chicago, Ill. E. E. Maher is in charge of the fire pump department, and A. F. Barron is in charge of the service pump department.

Scheuneman Joins Blaw-Knox

GEORGE D. SCHEUNEMAN, formerly Assistant Division Engineer of the Division of Highways of Ohio, has joined the sales force of the Blaw-Knox Company, Pittsburgh, Pa., and will be connected with the road department at its Chicago office in the Peoples Gas Building, according to a recent announcement.

Third Annual Saint Paul Building Show

THE Third Annual Saint Paul Building Show, conducted under the auspices of the Saint Paul Builders Exchange, will be held at the Saint Paul auditorium, Saint Paul, Minn., the week of March 10-15. The entire building will be devoted to exhibits, and the space to be occupied will be almost double that of any previous show. Detailed information regarding the show may be secured from A. V. Williams, Secretary, Builders Exchange, Saint Paul, Minn.

Milwaukee Company Establishes Plant at La Crosse

THE Milwaukee Corrugating Company, Milwaukee, Wis., manufacturers of Milcor sheet metal products, have recently announced the purchase of several factory buildings and the establishment of a branch plant at La Crosse, Wis. The strategic position of these new factories will be an important factor in maintaining the company's policy of "same day" shipment on all standard lines.

Frank Vyvyan has gone to the La Crosse plant as manager. He has had over 12 years' service in the Milcor organization and is well equipped to extend helpful service to the trade in that territory.

The Milwaukee Corrugating Company now operates branches at Kansas City and La Crosse and a branch sales office at Minneapolis in addition to its factories at Milwaukee, which were increased in 1923 by an addition of 50,000 square feet of floor space and which will be further increased this year. The new factory has added 150,000 square feet of floor space to the company's facilities.

New Truscon Advertising Manager

THE Truscon Steel Company, Youngstown, Ohio, has announced the appointment of Peirce Lewis as advertising and sales promotion manager. Mr. Lewis will have complete charge of this department, which is now located at the home office and plant in Youngstown, Ohio. The department was formerly in Detroit, Mich. He has had a wide experience in advertising and sales work, having been connected with the Kawneer Manufacturing Company and the Detroit Steel Products Company, and assistant advertising manager of the Truscon Steel Company.

Large Structural Steel Order

WHAT is said to be the largest order of structural steel that has ever been placed in Nebraska was received in December by the Omaha Steel Works, Omaha, Neb., for more than 3,500 tons of steel to be used in the erection of a new viaduct spanning the Union Stock Yards at South Omaha, according to Karl Vogel, General Manager of the Omaha Steel Works, who secured the order.

The new viaduct, which was planned by Everett Buckingham and other Stock Yard officials, starts at the west end of the L Street viaduct, spans the Stock Yards and goes straight south to O Street, and thence east to the end of the present O Street bridge. The structure will be 2,100 feet long and 74 feet wide. The molding of the steel is already under way, and deliveries will be made shortly.

Expansion of Bear Tractors Organization

THE Sales Organization of Bear Tractors, Inc., 5333 Park Place, New York City, has been expanded through the appointment of H. A. Reed as General Sales Manager and R. C. Brewsaugh as Assistant Sales Manager and Advertising Manager. Both will make their headquarters in the New York office.

Mr. Reed has grown up in the tractor business, having been connected with the International Harvester Company, the Case Threshing Machine Company, the Hart-Parr Company, and the Allis-Chalmers Manufacturing Company. Mr. Brewsaugh has been associated with Mr. Reed throughout this work.

C. A. Bishop has been appointed District Sales Manager of the territory comprising Minnesota, the Twin City Territory, Iowa, the Dakotas, Nebraska, Kansas, Western Missouri, Colorado and Wyoming. Mr. Bishop's headquarters will be in Kansas City. He was formerly with the Hart-Parr Company.

Harvey E. Sewall has been made Assistant Sales Manager, with headquarters in Philadelphia.

The Export Department of this company will be handled by Pablo Homs, who is said to be one of the oldest tractor exporters in this country.

Changes in P & H Southern Offices

PAWLING & HARNISCHFEGER COMPANY, Milwaukee, Wis., has recently opened new offices in the South. N. B. Norris, formerly District Manager at New Orleans, is now District Manager of the Memphis, Tenn., office. D. J. Murphy, formerly of the New Orleans office, is now District Manager of the Texas district, with headquarters at Dallas. F. W. Truex will continue as District Manager at Atlanta, Ga., with offices at 212 Haas-Howell Building. W. J. Dugan, as Southern Sales Manager, will assume charge of the entire southern territory with headquarters at Memphis. For the convenience of P & H customers, a complete stock of excavator renewal parts will be maintained at Memphis.

Founder of J. D. Adams & Co. Dies

J. D. ADAMS, founder and head of the firm of J. D. Adams & Company, Indianapolis, Ind., passed away on January 17, following a brief illness with pneumonia. Mr. Adams is nationally known as the inventor of the Adams adjustable leaning-wheel grader, and because of his close contact with road officials all over the country, particularly in the earlier years of the firm's history, he will be remembered by many of the old-time road men. In the latter years of his life, Mr. Adams spent most of his time on experimental work, the active management of the business being in the care of his sons, R. E. Adams, General Manager, and W. R. Adams, General Sales Manager, who will continue in active charge.

Latin-American Engineers to Study Our Roads

FORTY Latin-Americans of broad experience in highway affairs are to be invited by the Highway Education Board to come to the United States for a very close study of every angle of the American highway movement. These representatives will take a three weeks' trip next summer through several of the more progressive highway states. The trip is being planned so as to give the visitors a chance to learn first-hand what our vast experience in highway building and highway transport has taught us.

The idea of inviting these experienced men from our sister republics to come here was suggested by arrangements which are being made for a Pan-American motor highway conference. This conference was sanctioned at the Fifth International Conference of American States held in March, 1923, at Santiago, Chile.

Organization of Gramm-Bernstein Truck Corporation

A REORGANIZATION committee has purchased the property of the Gramm-Bernstein Company, Lima, Ohio, in accordance with a plan which was agreed to by the interested parties several months ago. The property will be immediately transferred to a new corporation, to be known as the Gramm-Bernstein Truck Corporation, which will continue the business under the present management and entirely free of indebtedness.

New Addition to Ransome Plant at Dunellen, N. J.

A NEW building having a ground area of 340 by 64 feet and representing a 50 per cent increase in manufacturing floor space compared with that of the original building, has just been added to the plant of the Ransome Concrete Machinery Company, Dunellen, N. J. The new structure is of concrete and structural steel, with full-length windows swung from a point 5 feet above the sills to the eaves, and can readily be increased to double its present length. It contains two 5-ton cranes traveling the full length of the building, and in addition is completely equipped with shears, punch presses, and riveting machines for use on the structural and plate material used in the manufacture of Ransome concrete machinery.

The occupancy of the building has made possible a number of improvements in the routing of material and work through the plant, and a consequent increase in daily output considerably greater in proportion than the increase in available space.

In addition to the erection of the new building, a field of ample size has been secured for testing the traction equipment of Ransome pavers under their own power, and a stand has been built for testing the drum mechanism and other parts of Ransome building mixers. Interdepartment movement of materials and work is now accomplished by means of electric trucks and trailers instead of the tramway system formerly used. A restaurant for employees has been installed, and plans for new office and administration buildings are being considered.

ARCHITECT'S SKETCH OF ADDITIONS TO RANSOME PLANT

Building Conditions in the United States

Prepared by S. W. Straus & Company

1923 a Year of Building Records

NEW records in volume of building permits were established for the year 1923 and for December of that year. Much significance is attached to the fact that 266 comparable cities reported a loss from November to December of only approximately 10 per cent, whereas the general tendency for the whole country has been a loss of from 20 to 25 per cent between the eleventh and twelfth months.

The same 266 cities in December gained 18 per cent over December, 1922.

The amount of permits issued in December taken in conjunction with the unusual volume of permits issued in October and November, indicates the likelihood of a continuance of extensive winter building.

Based on the amount of permits reported from 266 cities ($3,321,041,799) the volume of building during the year 1923 for the entire country may be estimated at approximately $5,500,000,000. The 266 cities show an increase for the year 1923 over 1922 of 24 per cent.

One of the most interesting facts in connection with this stupendous total of construction is shown in the accompanying table of the twenty-five cities (classified according to volume of building permits for the year). These cities, representing exactly 20 per cent of the population of the country, did nearly 50 per cent of the nation's building.

March holds the record for the greatest building month of the year 1923. The monthly curve, which began to rise in January, reached its apex in March; dropped steadily until July; rose slightly in August; dropped considerably in September and through October and November rose.

Every region in the country, East, Central, South and Pacific Coast, gained over the year 1922, ranging from 14 per cent in the Central to 36 per cent in the Pacific West. Each of these regions also gained in December, 1923, over December, 1922, excepting the South. The percentage of gain for the regions of the country, both during the year and for December, 1923, over 1922, are shown in the accompanying summary.

The twenty-five leading cities (according to volume of building for the entire year) show that astonishing progress is being made in the country's populous centers. Greater New York shows a total exceeding twice the amount of building in Chicago, which was the second city in volume for the year. Chicago's percentage of gain for the year, however, was 45 per cent against 25 per cent in Greater New York. If Brooklyn were considered as a separate city, it would be the third, numerically, on the year's showing, but since it is considered as a borough of Greater New York, Los Angeles takes the third position.

Among the twenty-five leading cities, Los Angeles shows the highest percentage of gain for the year, the figures of a few of the high ones being: Los Angeles, 65 per cent; St. Louis, 64 per cent; St. Paul, 60 per cent; Milwaukee, 54 per cent; Chicago, 45 per cent; Detroit, 37 per cent; Atlanta, 31 per cent; Cleveland, 26 per cent; and New York, 25 per cent.

Building Material

Movements in the building materials market in December were somewhat irregular. A few commodities in some cities showed further declines; for instance, cement in New York City, finishing materials in New York City, starting materials in Chicago, and some grades of lumber. On the other hand, common brick and starting materials in the East have tended upward. Structural steel shapes still remain firm at the level reached some months ago. On the whole, while the general level may have tended downward, the decline is undoubtedly less than the usual seasonal movement.

SUMMARY OF YEARLY AND DECEMBER REPORTS BY REGIONS

No. Cities	Regions	Year 1923	Year 1922	Gain 1923-1922	Dec., 1923	Dec., 1922	Gain Dec.-Dec.
91	East	$1,545,323,933	$1,313,494,126	$231,829,807 18%	$147,376,734	$120,034,548	$27,342,186 23%
85	Central	1,055,061,243	812,517,435	242,543,808 30%	81,388,841	74,882,964	6,505,877 9%
37	South	226,208,396	198,341,792	27,866,604 14%	17,157,798	21,811,631	*4,653,833 21%
53	West	494,448,227	362,930,519	131,517,708 36%	41,641,669	26,759,938	14,881,731 56%
66	Total	$3,321,041,799	$2,687,283,872	$633,757,927 24% net gain	$287,565,042	$243,489,081	$44,075,961 18% net gain

—(*) Indicates loss.

TWENTY-FIVE CITIES SHOWING GREATEST VOLUME OF PERMITS FOR YEAR 1923

		Year 1923	Year 1922	Gain Yr. 1923–Yr.'22	Dec., 1923	Dec., 1922	Gain Dec.-Dec.
1.	New York	$792,911,559	$636,401,229	$166,678,321	$91,084,414	$71,977,868	$19,106,546
2.	Chicago	329,604,317	227,842,010	101,762,307	21,740,450	34,403,200	12,662,750*
3.	Los Angeles	200,133,181	121,206,787	78,926,394	20,758,194	8,955,597	11,802,597
4.	Detroit	129,662,711	94,615,093	35,047,618	10,440,864	7,064,832	3,376,032
5.	Philadelphia	123,511,935	114,881,040	8,630,895	5,298,995	7,967,360	2,668,365*
6.	Cleveland	69,390,540	55,147,565	14,242,975	11,018,275	4,217,150	6,801,125
7.	Washington, D. C.	49,623,605	47,915,399	1,708,206	3,271,080	4,639,575	1,368,495*
8.	San Francisco	49,594,011	45,327,206	4,266,805	4,952,444	2,439,658	2,512,786
9.	Baltimore	46,988,002	43,263,210	3,724,792	3,629,160	5,919,770	2,290,610*
10.	St. Louis	41,443,755	25,210,503	16,233,252	3,464,570	2,341,871	1,122,699
11.	Boston	40,626,352	57,496,972	16,870,620*	3,825,590	2,098,111	1,727,479
12.	Milwaukee	39,007,845	25,250,312	13,757,533	2,389,352	1,873,767	515,585
13.	St. Paul	35,735,627	22,388,862	13,346,765	4,485,342	926,827	3,558,515
14.	Pittsburgh	32,915,312	35,255,375	2,340,063*	2,967,283	2,322,640	644,643
15.	Minneapolis	32,315,545	29,470,500	2,845,045	2,804,280	1,200,280	1,604,000
16.	Newark	32,226,106	28,585,171	3,640,935	3,737,357	2,119,010	1,618,347
17.	Buffalo	27,907,000	25,891,120	2,015,880	2,371,000	2,275,000	96,000
18.	Oakland, Calif.	27,628,897	24,468,223	3,160,674	2,583,312	2,070,582	512,730
19.	Indianapolis	27,307,279	26,110,607	1,196,672	1,853,898	1,729,503	124,395
20.	Cincinnati	27,160,520	26,034,000	1,126,520	2,556,905	1,398,850	1,158,055
21.	Atlanta	27,094,498	20,584,736	6,509,762	2,340,656	1,392,779	947,877
22.	Portland, Ore.	25,247,135	22,734,600	2,512,535	1,452,860	808,725	644,135
23.	Kansas City, Mo.	24,841,756	23,145,990	1,695,766	1,486,200	1,547,450	61,250*
24.	Long Beach	23,693,580	14,041,418	9,652,162	1,255,104	851,360	403,744
25.	Seattle	22,482,678	19,783,835	2,698,843	1,060,930	1,792,685	731,755*
		$2,279,053,746	$1,813,051,763	$466,001,983 26% net gain	$212,829,515	$174,334,450	$38,495,065 22% net gain

* Indicates loss

January Continues to Gain

OFFICIAL reports from 268 cities show that building permits issued during the first month of the year were 10 per cent in excess of January a year ago, which in turn was a record-breaking January in the history of the building industry. The percentage of gain in three sections of the country was even greater than the gain for the country at large. The South gained 25 per cent, the West 23 per cent, and the East 17 per cent. The Central section showed a loss of 13 per cent.

The loss in the Central West was due somewhat to the slowing down in Chicago, where a decline of substantially $4,500,000 was revealed. In some other cities of the Central region losses were sustained.

The total for 280 cities this January was $236,286,583. The total for 268 cities was $234,818,176, compared to $212,950,663 in January, 1923.

The predominating percentage of building in the larger cities of the country is more surprising than ever before. Twenty-five cities showing a largest volume of permits issued in January this year had a total of $169,691,096, or 12 per cent more than last January and 57 per cent more than January, 1922.

The total for these twenty-five leading cities in January this year was 71½ per cent of the total reported in 280 cities, thus illustrating how the volume of construction is increasing in the larger cities and towns.

The outstanding cities, in point of gains over last January, were: New York, 16 per cent; Los Angeles, 17 per cent; Philadelphia, 33 per cent; Seattle, 220 per cent; Long Beach, 131 per cent; and Houston, 192 per cent.

The significance of the reports here recorded lies mainly in the fact that they indicate the possible inception of another exceedingly active spring building season.

Material and Labor Situation

January witnessed continued stability in building material prices. The few changes that occurred were largely confined to New York City, Atlanta and a few cities in the Pacific Northwest. Slight increases were reported in cement and other concreting materials. Stocks of lumber and brick increased. Lumber prices declined somewhat. Other materials did not show any significant changes. The labor situation was reported as well stabilized.

SUMMARY OF JANUARY REPORT, BY REGIONS

No. Cities	Regions	Jan., 1924	Jan., 1923	Dec., 1923	Gain Jan.-Jan.	Loss Dec.-Jan.
89	East	$123,836,064	$105,674,519	$146,466,063	$18,161,546 17%	$22,629,909
88	Central	51,754,683	59,431,908	86,571,918	*7,677,225 13%	34,817,235
38	South	20,830,993	16,626,714	21,438,316	4,204,279 25%	607,323
53	West	38,396,436	31,217,522	40,811,675	7,178,914 23%	2,415,239
268	Total	$234,818,176	$212,950,663	$295,287,972	$21,867,513 10%	$60,469,796

Note—(*) Indicates loss.

The Use and Service of Core Drills

Contractors May Secure Much Information Regarding Subterranean Work Through the Use of Core Drills in Advance of Excavation

THE core drill is a rock-boring machine well known to contractors throughout the world. They have come to consider it indispensable for determining positively the formations beneath proposed locations of bridges, dams, piers, canal locks, large buildings and other heavy construction, as well as in testings for railway road-beds, canals, aqueducts, and tunneling projects. These drills are also used for boring wells, plunger elevator shafts, and holes for ventilating mines and for cableways.

Shot Drills Versus Diamond Drills

The McKiernan-Terry core drill is of the shot type, which is said to be much more economical in first cost and in operation than other types of core drilling machinery. One outstanding advantage of the shot drill is that it

CORES FROM A 29-INCH BORE HOLE, SHOWING TYPE OF MATERIAL CUT

From left to right, the second of these cores shows part of a 2-inch water pipe cleanly cut. The third core was cut through a section of 8-inch I-beam, and the fourth indicates by its faults the imperfect setting of the concrete and by the plainly evident parallel layers shows its former relation to the horizontal

Range and Capacity

Holes up to 30 inches in diameter have been cut with core drills made by the McKiernan-Terry Drill Company, 19 Park Row, New York City. On one operation a 10-inch hole was drilled to a depth of 2,000 feet in a granite rock without reduction in diameter. Standard machines are furnished for 4-inch holes up to 4,000 feet deep, or larger holes to lesser depths, and special machines are built to order for even greater capacities.

As to cutting materials, it is claimed that no material has as yet been encountered which could not be cored successfully with McKiernan-Terry apparatus, and illustrations show steel beams, iron pipe, concrete reinforcing bars and other equally tough materials which have been cut through without difficulty.

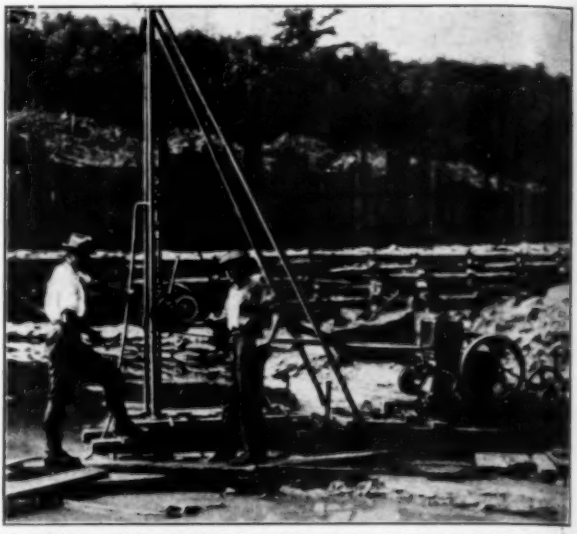
will cut cores of larger diameter, which furnish much more reliable information by reason of their larger cross-section and at less expense than the small cores such as are cut by the diamond drill. The shot drill cores a straighter hole and requires less water for operation. The loss of a shot tool in a hole is a very trivial matter, whereas the loss of a diamond bit, or even individual stones, involves great expense. Finally, shot drill cores are easily obtained in soft and friable materials which will not hold together in a small core, but can be extracted readily in cores of large diameter.

The diamond drill has one advantage. It

will cut at any angle up or down, while shot drills are restricted to angles of not more than 45 degress from the vertical.

The Smallest Core Drill Outfit

The Class Z-1 drill, which bores a 2¼- or 3-inch hole, giving a 1¼- or 1¾-inch core, can be packed small enough to be carried to any place where a man can go with mules, and has been used on construction work with most satisfactory results in making foundation borings for engineering data. The outfit is light, yet strong, is very easy to set up and remove, and will bore a 2¼-inch hole to a depth of 400 feet. It is usually operated with a gasoline engine, to which it is belt-connected. It is fitted with a hand-operated hoist used for driving casings and for raising and lowering the drill rods in the bore hole. The head swivels so that angular borings can be made.



A SMALL CORE DRILL AT WORK NEAR PORT JERVIS, N. Y., TESTING THE FORMATION ADJACENT TO A DAM

Several times this drill had to be moved away from the uncompleted work to permit blasting operations. This was done readily, as the apparatus is not heavy

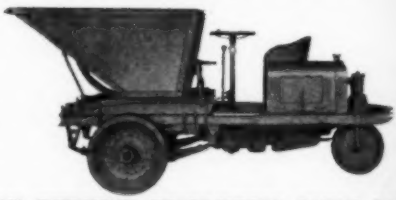
The drill is well adapted to testing concrete roads, floors of concrete buildings, etc., and for shallow work of this character holes up to 8 or 10 inches in diameter can readily be bored. It is made in larger sizes capable of handling larger tools at greater depths.

The Automatic-Dump, Three-Wheel Tructractor

Machine for Handling 24 Cubic Feet of Material Has Many Unusual Features

THE automatic-dump Tructractor with its three-wheel construction, giving it a very short turning radius, and with the load carried in front of the driver and over the driving wheels, insuring ample traction, is a machine which has many possibilities for the general contractor. The automatic dump type of this machine handles dry and wet materials, such as coal, ashes, sand, concrete, refuse, scraps, etc., and can be used in narrow places where the headroom is low. The machine measures 137 inches over all, is 46 inches wide and stands 60 inches high. The ground clearance of the body in dumping position is 5½ inches. The entire machine weighs 2,500 pounds, and it can carry 24 cubic feet of material.

A 2-ton model of the Tructractor is also made by the Clark Tructractor Company, Buchanan, Mich., and is built for use where exceptionally heavy duty work is required, especially for street, alley and highway contractors. This machine weighs 4,000 pounds and carries 30 cubic feet of material. The machine is so constructed that the driver can trip the hopper, dump the load and recover the body without dismounting. The hopper is built to insure clean dumping, and because of the three-wheel construction it is possible to turn quickly and to readily spot the load on the job.



AN EFFICIENT THREE-WHEEL TRUCK FOR ROAD BUILDERS AND BUILDING CONTRACTORS

A DRIVER CAN DUMP A LOAD OF SAND AND GRAVEL DIRECTLY INTO THE MIXER SKIP WITHOUT DISMOUNTING

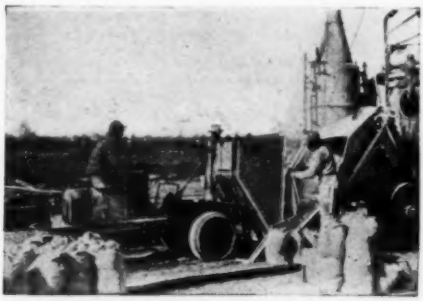
Tructractors on Chicago Building Job

Recent observations on several Chicago jobs noted in *The American Contractor* show that it is possible that the day of the man-hauled buggy or car on excavation work is rapidly drawing to a close. Two Chicago contractors have borrowed a hint from the highway builders and installed Tructractors to do the hauling work in the excavation. Henry Ericsson is using them on the second half of the Merchants Bank Building, and W. J. Newman is using them on the Straus project and the Burnham Building.

The report states that on the Burnham Building a fleet of these trucks is being used to haul the dirt from the caisson heads to the elevator which lifts the dirt to the street and dumps it into a large truck for disposal. The same Tructractors in the excavation were used also to haul the fresh concrete from the mixer to the caissons and to dump the batch into place. These trucks are of the ¾-yard and 1-yard sizes having a dump body of convenient shape and are powered with a gasoline motor with four cylinders of 3½-inch bore, capable of shooting the truck around at a good speed.

Because of the weight of the trucks and the speed necessary to make their use economical, a strong runway must be provided if the ground is at all soft. This runs up the cost of operation, but when the size of the job warrants, as on the Burnham job, the cost of this method of transporting material is somewhat lower than that of the older method. In order that the bucket may be dumped directly into the Tructractor, it is necessary to elevate the caisson heads sufficiently to clear the rim of the dump body. Concrete mixers must be similarly elevated for the same reason. A hopper and chute at the ground level of the caisson heads receive the batch of concrete when dumped from these trucks.

The Burnham Building is named in honor of the famous architect, the late Daniel H. Burnham, whose firm designed the building. The owner of this $8,000,000 structure is the Courts Building Corporation, headed by Frederick T. Hoyt, with offices at 138 North La Salle Street, Chicago. The general contract was awarded to the Starrett Brothers Company, 8 South Dearborn Street, and the excavating was done by the W. J. Newman Company. The building will be 20 stories high, 180 by 162 feet, and will be a steel skeleton structure with brick curtain walls, cut stone trim and hollow tile floor slabs.



AFTER DUMPING THE AGGREGATE INTO THE MIXER ACCURATELY, THIS MACHINE QUICKLY TURNS AROUND AND SPEEDS AWAY FOR THE NEXT LOAD

Missouri Develops New Type of Road

A Sledge Stone Base Adopted as Standard for Bituminous Roads

A SLEDGED stone base with penetration macadam or asphaltic concrete surface has been adopted as a standard type of construction by the State Highway Department of Missouri. On the porous, easily drained soil in large sections of the state, these bases are being laid at an appreciable saving and are standing up in an excellent manner. Quarry rock that is too soft to provide a crushed stone can be readily applied to the sledged base. Both limestone and sandstone have been used.

Missouri is rich in local materials, and the Highway Department has embarked upon the policy of utilizing these materials as much as possible so as to cut down the cost of highway construction. In large sizes the sledged stone is less objectionable, it is declared, than the crushed stone. The large stones break down very slowly, because of internal movement of the fragments when subjected to heavy traffic. The large stones during construction are bound together and interlocked by sledging, after which the interstices are filled with spalls, small stones and screenings. The whole is then rolled firm and smooth. On this base any type of bituminous surface can be laid.

Contractors' Equipment at Work on Paving and Building Jobs

WHITE 5-TON TRUCK OWNED BY M. J. MALLOY, ROAD CONTRACTOR, SUGAR NOTCH, PA.

FWD TRUCK OPERATED BY MOSHER MANUFACTURING COMPANY, DALLAS, TEXAS

At the time the photograph was taken, the truck was pulling a 5½-ton Warner two-wheel trailer and was loaded with a girder 42½ feet long, weighing 24,200 pounds. A derrick was being used to raise the girder from the truck and lifted it about 1½ feet above the trailer, when the derrick broke, dropping the girder back onto the truck and trailer. In spite of the fact that the derrick boom was badly damaged, neither the trailer nor the truck was injured in any way through this accident

LOADING ROCK ONTO A MODEL 68D GARFORD TRUCK OPERATED FOR R. WADDINGTON SONS COMPANY, HOBOKEN, N. J., CONTRACTORS

A WONDER ONE-BAG MIXER CHUTING CONCRETE INTO THE BASEMENT OF THE NEW NORTHWESTERN LIFE INSURANCE BUILDING, MINNEAPOLIS, MINN.

This mixer, made by the Construction Machinery Company, Waterloo, Iowa, was sold to the contractor, The J. L. Robinson Co., Minneapolis, by William H. Hale & Company, of that city

Catalogs of Worth
The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

SURFACING WITH BITUMINOUS MATERIALS

Literature which may be secured from the Kinney Mfg. Co., 3529 Washington St., Boston, Mass., will be of material aid to contractors having or contemplating securing contracts for road surfacing with bituminous materials, either hot or cold.

INDUSTRIAL RAILWAY EQUIPMENT

The need of industrial railway equipment for certain types of road construction is well appreciated by most contractors. Bulletins describing an economical type of industrial railway equipment, including portable track and switches, batch boxes and square box dump-cars may be secured without charge from the Koppel Industrial Car and Equipment Co., Koppel, Pa.

DOUBLE-ACTING PILE HAMMERS

McKiernan-Terry 9B and 11B double-acting concrete pile-driving hammers which are controlled entirely by steam throttle valves are described in Bulletin 31, which may be secured free from the McKiernan-Terry Drill Co., 19 Park Row, New York City.

STORM CULVERTS THAT LAST

When specifying or bidding on a culvert job, look into the ultimate economy of the use of genuine open-hearth iron rust-resisting culverts described in the literature of the Newport Culvert Co., 542 West Tenth St., Newport, Ky. The literature of this company contains very interesting and helpful information.

FILLER ASPHALT FOR BRICK STREETS

The brick manufacturers are now recommending the manufacture of an asphalt filler for brick pavements. A high grade of asphalt filler for this work, made to meet the strictest filler specifications, is made by the Pioneer Asphalt Co., Lawrenceville, Ill., which will be pleased to send quotations and information regarding it to any interested contractors.

WHEELBARROWS FOR EVERY JOB

Particulars regarding the best types and sizes of wheelbarrows adapted to different jobs and materials may be secured from the Puffer-Hubbard Mfg. Co., Minneapolis, Minn., manufacturers of all kinds of wheelbarrows.

AN ENGINE YOU CAN'T BEAT UP

Contractors' work is necessarily hard on the machinery and automotive equipment. Proof that Hercules engines will stand up on the job is found in the interesting illustrated literature of the Hercules Corp., Engine Div., Evansville, Ind.

HEAVY-HAULAGE TRUCKS

The light-weight truck has its place in contracting, but when it comes to the serious heavy-haulage problem, a contractor will study literature describing 1½ to 7½-ton heavy-duty trucks such as made by the International Motor Co., 45 Broadway, New York City.

PORTABLE PUMPING PLANTS

Barnes road builders' pumping plants of all types and sizes are described in detail in illustrated Bulletin No. 105, which may be secured from the Barnes Manufacturing Co., Mansfield, Ohio.

HAMMER AND TRIPOD DRILLS

Drills for all kinds of contracting jobs, which have a reputation for standing up and accomplishing results economically and quickly, are described in the literature of the Wood Drill Works, 30-36 Dale Ave., Paterson, N. J.

IT SCREENS, CRUSHES AND LOADS GRAVEL

The new Russell portable screening, crushing and loading plant is a valuable machine for contractors who want to produce the right kind of material for road graveling. This plant is described in the literature of the Russell Grader Mfg. Co., Minneapolis, Minn.

LIGHT-WEIGHT TRACTORS FOR HAULING

Contractors interested in securing a light-weight tractor that can be used for various haulage work and is readily convertible into an industrial locomotive, can secure information from the Fordson Tractor Co., Detroit, Mich.

A LIGHT-WEIGHT DITCHER

The Topping Pony Ditcher, which is a thoroughly dependable, light-weight, reasonably priced, and cheaply operated traction ditching machine for center or side work, is described in a well-prepared, illustrated folder which may be secured from the Charles T. Topping Machinery Co., Dayton, Ohio.

BUILDING BRICK PAVEMENTS

The National Paving Brick Manufacturers Association, 830 Engineers Bldg., Cleveland, Ohio, has just issued a descriptive booklet, "The Construction of Vitrified Brick Pavements," including recommended specifications, which may be secured by any interested officials or engineers or contractors free upon application.

PRECAST CONCRETE GRADE CROSSINGS

In a booklet, R-12, the Portland Cement Assoc., 111 W. Washington St., Chicago, Ill., describes precast concrete highway grade crossings, showing their feasibility, present service, suggested designs, specifications, and instructions for installing the slabs.

BLADES FOR ROAD GRADERS

Superior-quality grader blades for all makes of road graders and drags are described with specifications in the literature of the Shunk Mfg. Co., Bucyrus, Ohio.

HIGH-GRADE ASPHALT CEMENT

The use of an asphalt binder which stands well with engineers is a point in favor when contractors are bidding on asphaltic work and is of advantage to a contractor. Any information desired regarding construction of asphaltic roads will be furnished without charge by the Texas Co., Asphalt Sales Dept., 17 Battery Pl., New York City.

UP-TO-DATE ROAD CONSTRUCTION

The illustrated booklet of the Warren Brothers Co., 9 Cambridge St., Boston, Mass., describes the use of Warrenite-Bithulithic asphaltic concrete which has shown remarkable wearing qualities over a long span of years. Literature describing this type of construction may be secured free on request.

SIMPLICITY IN DUMPING MECHANISM

The Wood Detroit hydraulic hoist consists simply of a piston and two gears working in oil, which, it is claimed, increases their dependability and efficiency as shown in the thousands of installations made in the last 30 years. These hoists are described in the literature of the Wood Hydraulic Hoist & Body Co., 7938 Riopelle St., Detroit, Mich.

EXTENSION BLADES FOR ROAD MAINTAINERS

The Highway Maintainer Company, Lincoln, Nebr., manufacturers of road machinery, also makes an extension blade which can be used on its maintainers, which makes it possible in light going to materially increase the area covered by a blade grader and which can be used also in working ditches at the same time that the road is being maintained.

FREE NOTE-BOOKS

The Warren-Knight Co., 136 N. 12th St., Philadelphia, Pa., has issued a note-book, ZA, which contains a calendar, cross-section pages useful to builders, contractors and engineers and also a section for modern practise in establishing lines and levels. This note-book, which furnishes a convenient means for preserving notes of costs, estimates and measurements, may be secured free from this company.

PUMPS FOR EVERY SERVICE

Literature which may be secured from Dept. 15, Aldrich Pump Co., Allentown, Pa., describes the Aldrich pumps, which are used particularly in contracting service and have proved economical and dependable.

ROAD FORMS THAT BUILD SMOOTH ROADS

The literature of the Blaw-Knox Co., 667 Farmers Bank Bldg., Pittsburgh, Pa., describes Blaw-Knox road forms with which contractors can build smooth roads that stand up under all kinds of traffic far longer than those that are rough or wavy.

DATA ON STEAM SHOVELS

Osgood steam shovels which are equipped with submerged-tube vertical boilers that are adapted to a wide range of adverse conditions in the contracting field, are described in literature which the Osgood Co., Marion, Ohio, will be pleased to send to any interested contractors.

"HOT MIX" WHEN YOU WANT IT

The Iroquois Sales Dept., Barber Asphalt Co., Land Title Bldg., Philadelphia, Pa., will be pleased to furnish information on its new Iroquois hot-mixing plant, which will produce 4 cubic feet of hot mix in 6 minutes.

A VEST-POCKET COMPUTER

The Philip Carey Co., 9 Wayne Ave., Lockland, Cincinnati, Ohio, will be pleased to furnish to any contractor or engineer one of its vest-pocket quantity scales, which tells at a glance the correct quantity of cement, sand, gravel and stone required for a cubic yard of concrete for any mix, and the lineal feet of Elastite expansion joint required per mile of pavement with any spacing and any paving width.

QUICKER PAINTING WITH LOWER COSTS

The use of Sprayco painting equipment, which saves 50 to 80 per cent on the cost of labor and materials and enables the contractor to finish his job in record time, is described in Bulletin E-G 91, which may be secured from the Spray Engineering Co., 60 High St., Boston, Mass.

WHO USES TRACTORS?

The C. L. Best Tractor Co., San Leandro, Calif., will furnish to any contractor, interested in economical hauling and the possible supplanting of horse-power by tractors, a list of the owners of Best tractors located in his immediate vicinity.

MEASURING-TAPES, RULES AND GAGES

General Catalog No. 7, which has just been issued by the Lufkin Rule Co., Saginaw, Mich., describes its very complete line, including cloth, metallic woven and steel tapes, micrometer calipers, squares, bevel protractors, dividers and calipers, thickness gages, rules, both steel and wood, log rules and other types of gages.

EQUIPMENT FOR EFFICIENT ROAD WORK

Heil Hydro-hoists and steel dump bodies which have particularly advantageous features for use on heavy trucks and also for Fords, are described in new Bulletins Nos. 131 and 132, which may be secured from the Heil Co., 1243 26th Ave., Milwaukee, Wis.

A NEW ROAD-BUILDERS' TRUCK LOADER

Bulletin 124, recently issued by the Haiss Mfg. Co., 142nd St. and Park Ave., New York City, describes the new Haiss path-digging truck loader built around a Fordson power-plant and particularly adapted for road work.

EXTRA-STRONG WHEELBARROWS

In Booklet No. 1, the Cleveland Wheelbarrow and Mfg. Co., P. O. Station D, Cleveland, Ohio, describes its complete line of Red Star wheelbarrows having trays with two bottoms to increase the strength and service of the barrows.

WELDING AND CUTTING APPARATUS

In a small 24-page booklet, the Alexander Milburn Co., 1416-1428 West Baltimore St., Baltimore, Md., not only lists a few of the representative users of Milburn acetylene welding generators, but describes the apparatus in detail, showing its value to contractors.

THE PART OF GRADERS IN ROAD BUILDING

J. D. Adams & Co., Indianapolis, Ind., will be pleased to send a copy of its new catalog, "Modern Road Building with Adams Adjustable Leaning Wheel Graders," to any contractors interested in the possible purchase of any type of road machinery.

THE USES AND SALE OF SLATE

Contractors, builders, engineers and architects interested in the use of slate because of its strength and remarkable sanitary qualities in all types of structures, may secure valuable help and information from the National Slate Assoc., 757 Drexel Bldg., Philadelphia, Pa.

AIR BRAKES FOR MOTOR TRUCKS

The Westinghouse Air Brake Co., Automotive Div., Wilmerding, Pa., in its new publication, 9058, describes the recently developed Westinghouse automotive brakes for motor trucks, a distinct advance in the safety of operation for this type of transportation unit.

ROAD AND ROOFING KETTLES

Specifications and instruction sheets covering Connery's complete line of non-leakable welded road and roofing tar and asphalt kettles may be secured by interested contractors or municipal officials free on request to Connery & Co., Inc., 400 N. Second St., Philadelphia, Pa.

PORTABLE CAR UNLOADERS

For handling crushed stone or sand and gravel from cars to trucks, the Universal Road Machinery Co., Kingston, N. Y., says that the Reliance portable car unloader will save more than its cost in one season. The catalog and price list which describes this loader may be secured by writing to this company.

REFINE YOUR OWN ASPHALT

By the use of the Littleford-Pullar asphalt-producing plant, contractors and municipal street departments may purchase crude bituminous material and refine it for asphaltic concrete, sheet asphalt, penetration or any other type of asphalt paving. This machine is described in detail in a new bulletin which may be secured from Littleford Bros., 500 E. Pearl St., Cincinnati, Ohio.

EXCESS MACHINERY AT LOW PRICES

A list of excess machinery and equipment which is being offered at attractive prices that will interest contractors can be secured from E. I. Du Pont de Nemours & Co., Special Products Div., Room 7036, Du Pont Bldg., Wilmington, Del.

AN ASPHALT ROAD LAID COLD

Engineers and officials in charge of road and street construction or maintenance may secure an interesting booklet on rock asphalt for road work, which contains specifications that will be of interest to consider before signing new work. This Brochure CEM may be secured from the Kentucky Rock Asphalt Co., Inc., 711-713 Marion E. Taylor Bldg., Louisville, Ky.

A NEW 2½-TON COMMERCIAL TRUCK

The American-LaFrance Fire Engine Co., Elmira, N. Y., has just issued its new catalog, 103, describing the American-LaFrance 2½-ton commercial truck which it is making at its Bloomfield, N. J., factory.

STEEL TOWERS FOR CONCRETE

Instead of building a wooden hoist tower for distributing concrete to the forms, get a copy of Catalog 45, issued by the Insley Mfg. Co., Indianapolis, Ind., describing Insley concrete placing equipment, including the steel mast hoist plant which increases operating efficiency, as concrete can be placed by self-supporting chuting mounted on the tower.

A SPECIAL CONTRACTORS' WHEELBARROW

A wheelbarrow which was designed for the Chattanooga Wheelbarrow Co., Chattanooga, Tenn., by 15 contractors as a means of producing a barrow which would be a saver of time and effort, is described in literature covering the new "95 Special" concrete or mortar barrow. This company also makes many other kinds of wheelbarrows, which are described in its general catalog.

A COMPLETE LINE OF CEMENT TOOLS

"The Finishing Touch," an interesting publication issued by the Abrams Cement Tool Co., Detroit, Mich., describes its double-acting finishing tools, jointers, floats and edgers, which speed up all kinds of concrete surfacing work, whether it be roads, sidewalks or floors, and give excellent results.

Automotive Air Brakes

Better Control of Heavy Motor Trucks Made Possible Through the Application of Air Brakes to These Machines

THE air brake has for half a century been associated with transportation by rail and is now recognized as a necessity to insure prompt and safe travel on steam and electric railways. Now the air brake is being associated with highway transportation. The Westinghouse automotive air brake, made by the Automotive Division, Westinghouse Air Brake Company, Wilmerding, Pa., embodies the result of over 50 years' experience in the solution of braking problems, furnishing a power braking system which utilizes the force of compressed air in brake chambers, connected with the usual brake rods and controlled through a hand-operated or a foot-operated control valve. Pressure for operating the brakes is usually obtained from the engine itself through an accumulator, as it is called, although in some cases where the service requires it, a compressor driven from the power take-off of the transmission may be used for this purpose.

AIR BRAKE APPLIED TO MOTOR TRUCK

Applied to motor trucks, the automotive air brake prevents the possibility of costly accidents by providing a powerful means of stopping heavily loaded cars when necessity arises and of adequately controlling their speed while descending grades. Since the air does all the work, the driver being relieved of extra strain, there is no tendency towards careless driving such as is often induced by fatigue resulting from braking with the ordinary foot-pressure brake. Furthermore, because of this elimination of physical strain, there is no necessity for the truck and driver to be idle for any extended rest period, as has been known to occur where the service requires long trips with frequent stops of cars not equipped with power brakes.

Because less time is consumed in making the stop, the truck can run farther at a maximum speed, with the result that the average speed is higher and it takes less time to travel between two given points. This produces a greater day's mileage for the truck and more revenue for the owner. Since the air brake acts on the rear wheel brake drum and not on the propeller shaft, the wear and tear on all transmission elements that always accompanies the use of transmission foot brakes is eliminated. Because perfect and automatic equalization is inherent in the air brake, the possibility of skidding is very largely eliminated and the life of tires and brake linings is increased.

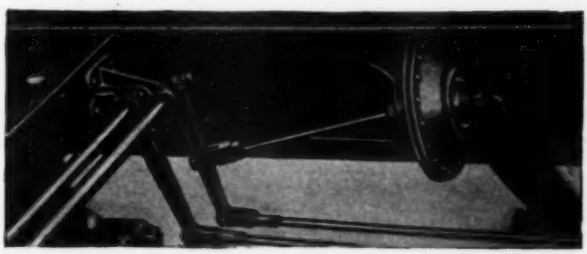
The first element in the automotive air brake system is the accumulator, which is generally attached to the engine in place of a pet-cock. One or two are used, depending upon the size of the truck and the service in which it is used. When the engine is started, a small amount of "air" under both the compression and explosion presses discharges to the storage reservoir and cylinder equipped with the accumulator. The amount is very small because of the restricted opening, and there is no appreciable effect upon the operation of the engine.

If no brake applications are made after the reservoir has reached full pressure, the engine ceases to discharge air into the reservoir, the

back pressure keeping the ball check valve in the accumulator. When the reservoir pressure drops through application of the brakes, the accumulator functions again and the pressure is restored.

The control valve for operating the brakes works in a similar manner and with no more effort than the operation of the accelerator. It is so designed that, in admitting air from the reservoir to the chamber to directly apply the brakes, a certain pressure will be established corresponding to the position of the control valve lever and irrespective of any excess pressure which may exist in the reservoir. A pressure of about 30 pounds will be created by the average engine when it is idling, but if it is working hard the pressure will go up in some cases to 200 pounds. A safety valve is used to prevent the reservoir pressure from rising above a predetermined amount.

The farther the control valve lever is moved from its released position, the greater will be the pressure in the brake chamber up to the extreme or emergency application of the lever. Whatever position the lever is placed in, the pressure corresponding to the position will be realized and automatically maintained in the brake chambers. Any desired pressure having been built up in the brake chamber, a graduated release may be effected at will by suitably returning the control valve toward its release position.



ONE METHOD OF APPLYING BRAKE CHAMBERS TO TRUCK

Operation of the control valve in detail is as follows: Movement of the lever toward application position closes an exhaust valve, opens an inlet valve, and loads a metal diaphragm by compressing a regulating spring. Air then flows from the reservoir to the brake chambers until the air pressure under the diaphragm is able to overcome the spring pressure above, when the inlet valve will close. A further movement of the lever compresses the spring still more and causes a balance to be established at a higher pressure. A movement of the lever toward release position permits the diaphragm to lift and open the exhaust valve to let out enough air to balance at a lower pressure.

Two types of control valves are available—hand-operated and foot-operated. The hand-operated valve is located on the steering column or on the dashboard. The foot-operated valve is mounted under the floor with an operating pedal projecting through. A gage to indicate the pressure available in the storage reservoir is located on the control valve.

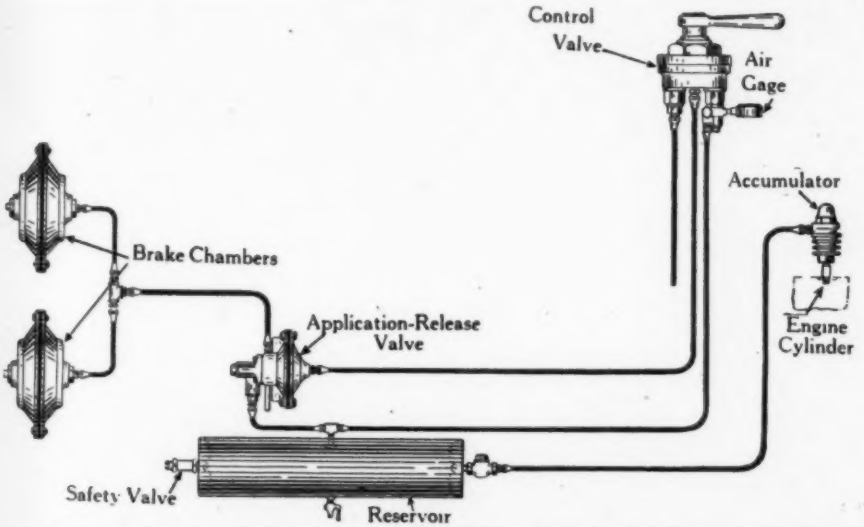


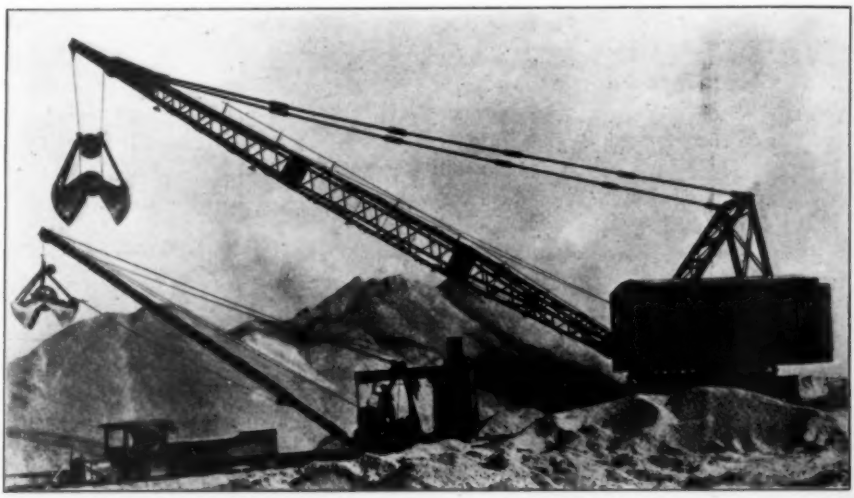
DIAGRAM SHOWING ARRANGEMENT OF AUTOMOTIVE AIR BRAKE FOR HEAVY-DUTY MOTOR TRUCKS

On heavy trucks two of the largest brake chambers are usually installed to provide for the development of the desired braking force. With such an installation or whenever the equivalent of one 9-inch brake chamber is needed, an additional device is used, called the application release valve. This valve is located close to the brake chamber and directly controls the admission of air from the storage reservoir to the brake chambers, in making the application and the exhaust of the air through the atmosphere when the brakes are released. The control valve then serves merely as a pilot valve to actuate the application release valve. By this method of application and release, more prompt action of the brakes is obtained than if all of the air was compelled to flow through the control valve.

Maximum Speed and Minimum Time for Unloading Sand and Gravel

Small Steam Crawler Crane and Big Electric Crane Function Perfectly Together

THE Birmingham Sand & Gravel Company, Detroit, Mich., has been confronted with the problem of unloading its cargoes of sand and gravel in minimum time and in moving this material from the docks into the adjacent storage yard, so that the dock may be cleared to care for the cargoes of other vessels. The problem has been very satisfactorily solved by the installation of a McMyler-Interstate electrically-operated traveling crane which handles the material at this plant with an unusual degree of rapidity.



A STEAM-OPERATED CONVERTIBLE CRAWLER CRANE WITH 40-FOOT BOOM, AND AN ELECTRIC CRANE WITH 90-FOOT BOOM CAPABLE OF HANDLING 4 CUBIC YARDS PER TRIP, USED AT THE BIRMINGHAM SAND AND GRAVEL COMPANY'S PLANT AT DETROIT, MICH.

The electric crane has a working radius of 90 feet and handles a clam-shell bucket having a capacity of 4 cubic yards. Under normal conditions the crane makes at least two trips a minute, swinging to an angle of 105 degrees and return. The hoisting speed with a maximum load is 200 feet per minute. The large crane is designed to travel on a track of 20-foot gage, either straight or with curves, having a 90-foot minimum radius. The crane has a wheel-base of 21 feet. The arrangement of the operating mechanism is such that any or all of the functions of the crane may be performed either singly or simultaneously.

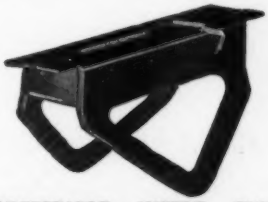
In front of the large crane will be seen a No. 2 steam-operated convertible crawler crane, also made by the McMyler-Interstate Company, Cleveland, Ohio, and equipped with a 40-foot boom and a 2-line ¾-yard clam-shell bucket. This crane is used for rehandling materials, as well as for loading into hoppers and trucks. It is also used for reclaiming materials at the edges of storage piles which are beyond the reach of large cranes.

Carrying Brick Veneer on Concrete Buildings

New Inserts as Substitutes for Cast-in Bolts Show Distinct Labor Saving

IT has been common practise to drill the wooden forms for the insertion of the bolts to fasten face-angles to carry brick veneer in concrete skeleton construction. David J. Johnson, a superintendent of construction in Chicago, devised a new and novel method of construction, thereby saving money in erection costs as well as providing a unique idea in construction, by the use of Truscon pressed steel adjustable inserts as substitutes for bolts. Mr. Johnson found that the saving effected in using adjustable inserts for anchors proved practical in a series of six large apartment hotels in Chicago. The satisfaction of a job well done meant more than any other feature on these jobs, although the substantial saving also illustrated the value of the idea in a practical way.

A study of costs for bolts as compared with inserts to carry face angles shows a saving of $3 per hundred in favor of the inserts. The costs are taken from a study of contractors' time sheets in various localities and are believed to be correct. Costs in detail are:



ADJUSTABLE INSERT FOR HOLDING SPANDREL GIRDERS

	Cents	Cents
Carpenter's time locating and drilling holes and placing bolts at 87½c.....	13	
Cost of ⅝ x 9-inch bolt.....	5	
Cost of extra nut to hold bolt at right angles to the forms.....	1	19
Cost of ⅝-inch pressed steel insert....	11	
Cost of ⅝ x 1¼-inch bolt to fasten face angles	2½	
Cost of placing insert.....	2½	16
Saving by use of insert.....		3

BELMONT HOTEL UNDER CONSTRUCTION

When 8,000 inserts or bolts are used in one building, a substantial cost is involved, merely in buying and placing the bolts or inserts, to say nothing of the labor saving to the steel men who are placing the angles. Bolts are subject to being bent over when struck by large scaffolding timbers, thus necessitating re-threading, and are often ½-inch or more out of line because of the sag in the concrete forms, which sometimes cannot be overcome. With the insert an inch of vertical adjustment is obtained, and the angles can be attached without the necessity of punching a new hole, even though the beam sags slightly. A bit of mortar is put in the bottom of the insert to provide a bearing surface.

SPANDREL HELD BY INSERTS TO HOLD BRICK WALL

With this method of carrying exterior brick work, it is essential that an insert be placed on each side of the column to carry the angle across the face of the column. Another essential is that the face angle be used at every floor level.

The accompanying photograph shows how the angle is attached to the concrete girder. In this illustration the angle has been placed to cover only half of the beam, in order that the inserts as well as the method of attachment may be shown. The insert used in this illustration is manufactured by Truscon Steel Company, Youngstown, Ohio.

A Water-Hammer Drill for Tunneling

A Mounted Machine Capable of Handling Light and Heavy Underground Drilling Work

A DRILL which the manufacturer claims combines high drilling speed, adaptability to hard and solid or soft, broken ground or to high and low air pressure, giving air power economy, light weight and convenience for the runner, together with simplicity and ruggedness, resulting in low repair cost, is being made by the Sullivan Machinery Company, 123 South Michigan Avenue, Chicago, Ill., and is known as the Sullivan DW-64 water-hammer drill. This water-jet hammer drill is intended for tunneling, drifting and all heavier kinds of underground drilling work for which a mounted machine is desirable. The machine weighs 130 pounds and may be operated by one man if desired. It is intended for heavy as well as light tunneling and drifting work and in actual practise is said to exceed the expectation of the designers in being able to handle long holes and heavy steel.

This drill handles 1¼-inch hollow steel in holes 12 to 18 feet in depth and has drilled to 25 feet. It is said to be notably free from vibration, making it easy for the runner. In soft, broken or fitchered ground, this drill clears itself remarkably well and drills a straight, true hole. In hard solid rock, its great power and hard, snappy blow give it a maximum drilling speed. Constant service during more than a year of operation has demonstrated the sturdy strength and excellent wearing qualities of the new machine.

Among the features of this machine which have been emphasized by the manufacturer are its valve and piston motions, consisting of the differential, three-spool independent valve, utilized so successfully in Sullivan rotators. This controls the action of the machine, giving a lively, powerful piston blow. The front and rear end cylinder cushions prevent damage to the drill and impart the smooth-running quality which reduces runners' fatigue and wear and tear on the machine.

The combined water and air jets for cleaning the hole and laying the dust, with separate control of each and the automatic rotation of the drill steel, together with the automatic differential pressure rotator, are other special features.

LIGHT-WEIGHT DRILL FOR CONTRACTORS

The chuck is enclosed, making it dust-proof, and is made in two parts with a separate locking ring for the steel. The drill is of all-steel construction, all parts of it, with the exception of the retaining bushing and rifle nut, being made either of drop-forged billets of alloy steel or from steel bars which are heat-treated and ground. The retaining bushing which transmits the rotation of the piston to the drill steel, and the rifle nut which carries the five spiral lugs which engage the rifle bar flutes, are made of bronze, insuring maximum wear of these parts and of those into which they fit. The front end rotating parts are positively lubricated by means of a grease chamber and grease gun. The DW-64 requires less clearance with the walls or roof of the drift or tunnel than any other drifting machine. Its compactness and small length is responsible for this advantage.

WE SUBMIT THAT—

A dollar in a building and loan association is worth fifty in a bucketshop.
—From a bulletin of the National Association of Real Estate Boards.

CATERPILLAR
Reg.U.S. Pat.Off.

ONLY HOLT BUILDS IT

Holt invented the "Caterpillar."* Holt perfected the "Caterpillar" and established it as a positive success in every part of the globe. The "Caterpillar's" principles of traction and construction, found in Holt basic patents, were correct from the first. They have stood every conceivable service test. Holt quality has never varied, has never been compromised to meet a price. "Caterpillar" Performance has been the one standard by which any tractive work could be measured. That is why *the world comes to Holt.* That is why the United States and foreign governments found only the "Caterpillar" ready for tremendous military responsibilities. That is why the greatest oil, lumber and mining companies, the most experienced engineers, contractors, road builders, public officials, farmers and ranch owners in over 57 different countries look to Holt to supply the most effective means of doing tasks too difficult and too important to entrust to any method or machine but the "Caterpillar." In every tongue, "Caterpillar" is a synonym for power, traction and economy. We invite correspondence from engineers, contractors, public officials and industrial firms in regard to any problems of overland hauling, dirt moving, snow removal or construction work.

* *There is but one "Caterpillar"—Holt builds it*

THE HOLT MANUFACTURING COMPANY, *Inc.*
PEORIA, ILLINOIS
***Eastern Division:* 50 Church Street, New York**
Branches and service stations all over the world

A New Asphalt Product

Material Composed of Water, Asphalt and a Filler Has Many Applications

A NEW asphaltic material which has wide application in the construction of asphaltic concrete roads, asphalt macadam roads and driveways, and sidewalks, in the repair of sheet asphalt, asphaltic concrete and asphalt macadam, water-bound macadam, tar roads, oiled roads, brick pavements and cement concrete, as well as for the surface treatment of concrete, bituminous macadam and water-bound macadam roads, has been placed on the market by the United States Asphalt Refining Company, 90 West Street, New York City, under the name "Ak-wa-falt." This material, as the name implies, is composed of water and asphalt, together with a filler. It is applied cold for all purposes where used.

A special application of this material is for grade crossings, whether for steam or electric railways, which have hitherto to a large extent been constructed with planking. This latter method of construction is now being superseded by the use of asphaltic compounds such as Ak-wa-falt. The material requires no heat to make it ready for use, and it can be used with wet stone, sand and gravel, thereby saving time, labor and fuel. Furthermore, its use does not require skilled labor or the services of an expert.

The material is shipped in wooden barrels and can be stored safely, as it contains no inflammable material. It can be kept indefinitely by the addition of a small amount of water to the barrel, sufficient to keep the material moist.

Another advantage claimed for Ak-wa-falt is that it can be used both in summer and winter, as freezing temperature causes no separation. Experience has shown that new construction and repairs made with Ak-wa-falt after setting up are tight and water-proof and have the appearance of sheet asphalt.

Grade Crossing Construction

In the construction of railroad grade crossings, where Ak-wa-falt is used in the wearing surface, the same method of taking care of drainage, subgrade and ballast is followed as where plank is used for the wearing surface. The wearing surface of Ak-wa-falt, 3 to 4 inches in thickness, is prepared of four parts of ¾-inch stone by volume, 2 parts of coarse sand by volume, and 1 part of Ak-wa-falt as it comes from the barrel by volume. Before combining the material with the mineral aggregate, about 15 per cent of water is added to the quantity of Ak-wa-falt previously measured, to bring it to a liquid state so that it will mix freely and coat all particles of the mineral aggregate. This is done in a separate container or in a concrete mixer. When the material is sufficiently liquid, it is combined with the mineral aggregate and turned over until all particles are coated. The mixture is then ready for placing. It is not necessary to let the mixture cure. However, if allowed to stand 24 hours, it will stiffen up and can be tamped in place more securely. If any voids appear on the surface after tamping, they may be sealed by applying a thin seal coat composed of one part of Ak-wa-falt to six parts of sand.

A Portable Screening, Crushing and Loading Plant

A COMPLETE portable plant which produces a good grade of material for road graveling and by which all oversize from the pit run is crushed, thereby adding to the aggregate the sharp, irregular material necessary for a firm, well-bound road surface, has been brought out by the Russell Grader Manufacturing Company, Minneapolis, Minn. Road builders recognize the value of using a certain portion of crushed material in road surfacing as

A PORTABLE CRUSHING AND SCREENING UNIT AT WORK IN A GRAVEL BANK

ABREAST OF THE TIMES

THERE WAS a time when the contractor using a 7-S or 14-S mixer had to build a concrete hoist tower for elevating the batch for distribution to the forms. That day is now of the past.

The Insley Steel Mast Hoist plant is of such first cost that no contractor is warranted in putting his money into a wood tower, and is of superior operating efficiency in that concrete can be placed from self-supported chuting.

Made to handle the output of either a 7-S or 14-S mixer, it is without an equal in the construction field. *Write for Catalog* 45.

INSLEY MANUFACTURING CO.

Engineers and Manufacturers

INDIANAPOLIS

90-ft. Insley Mast Hoist as being used by the Bedford Steel & Construction Co., in building the new University of Indiana stadium. The entire plant is mounted on a movable platform which can be shifted around the inside of the stadium as the work progresses. It provides maximum concrete placing efficiency at minimum cost.

INSLEY

CONCRETE PLACING EQUIPMENT

STEEL DERRICKS

BUCKETS AND CARS

EXCAVATING EQUIPMENT

compared with pit-run gravel. The only drawback has been the expense of producing such material. It is claimed that the new Russell plant brings down the cost and provides increased capacity. All units are combined in a compact, portable form which can be quickly moved from one place to another. Only one power-plant is required.

This machine takes material from the pit plant, crushes all oversize material, screens everything and loads trucks or, with an extended conveyor supported by horses, may be used to load bins. The hopper immediately below the screen holds enough material to fill a truck promptly without waiting.

The capacity of the plant depends entirely upon the quantity of oversize material passing a specified perforation into the crusher. It is said, however, that 300 to 600 yards a day can be delivered each working day. The operation of the plant is quite simple. The pit run of material is brought to the feed conveyor with a dragline, buck scrapers or drag scrapers, and the material is conveyed to a shaking grizzly or screen which passes all smaller material directly into the hopper below. The oversize passes over the perforated screen and into the crusher. The material passing through the crusher is carried back in a bucket conveyor and again deposited upon the grizzly. Should any of the crushed material still be too large to pass the round hole perforations in the screen, such oversize parts must again pass through the crusher. All material produced by this plant must pass through the screen. This makes the material uniform and certain to pass the specifications of the highway department. The delivery conveyor is a 24-inch belt, which loads the truck directly from the screen or from the auxiliary hopper.

These plants are also built for steam shovel work, in which case the feed conveyor is eliminated and a special receiving hopper is substituted.

The weight of this machine complete is 28,500 pounds and it is operated by a 45 to 50 horse-power engine. The crusher, which measures 8 x 36-inches, is built entirely of steel with manganese steel jaws, and a positive reduction to ¾-inch size in one operation. The hopper has a capacity of 3 yards. The feed conveyor has an all-steel carrier frame with a 24-inch belt and spool-shaped rollers. The standard length is 40 feet, but it may be extended by adding 10-foot sections and center supports.

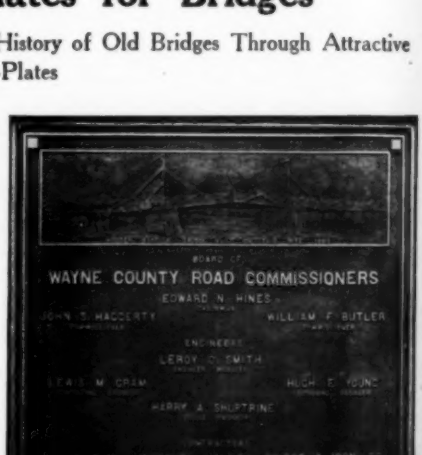
The grizzly, which measures 30 x 120 inches, is used to separate the oversize from the smaller material and is perforated as specified. The delivery conveyor is an all-steel adjustable conveyor having a 24-inch belt, and is 20 feet long. The frame is of all-steel construction and mounted on trucks with wheels having 12-inch tires and a 3¼-inch axle.

Historic Name-Plates for Bridges

Wayne County Road Commissioners Tell History of Old Bridges Through Attractive Name-Plates

IT is customary for a board of county road commissioners to place a name-plate on a new steel or concrete bridge containing the names of the members of the board, the board's title and the year in which the structure was built. It remained for the Board of County Road Commissioners of Wayne County, Detroit, Mich., to carry this idea to a greater length. On the modern steel bascule bridge completed in 1922 it has installed the usual name-plate with a picture of the old wooden bascule bridge built in 1882 shown at the top of it, as reproduced with this article. This relief was added to the usual name-plate because of the unique construction of the older bridge, which served its purpose for so many years.

During 1922, according to the latest report of the Board of Wayne County Road Commissioners, nine bridges were built, including the bascule bridges over the Rouge River at Jefferson Avenue West and Fort Street West. The bridge program of this Board is one of the greatest problems it has to face, with the ever-increasing motor truck traffic constantly entering and leaving Detroit. According to Edward N. Hines, Chairman of the Board, the policy has been to select bridges of types best suited to the locations and to combine in each bridge all possible elements of economy, usefulness and beauty.



AN INTERESTING HISTORIC NAME-PLATE

SEND TODAY FOR THIS NEW BOOKLET!

Solvay Calcium Chloride has been approved by engineers wherever it has been used, and is today recognized as a necessary material for concrete curing.

It is for use in all concrete work, and for use in mortar, in setting brick. Its efficiency is not impaired by the weather. The action of Solvay enables brick work and concreting to proceed at exceptionally low temperatures, as it lowers the freezing point of water, at the same time hastening the action. Because it is used integrally, Solvay hardens the entire mass and not just the surface.

For CONCRETE CURING

use **SOLVAY**

Free Running

Calcium Chloride

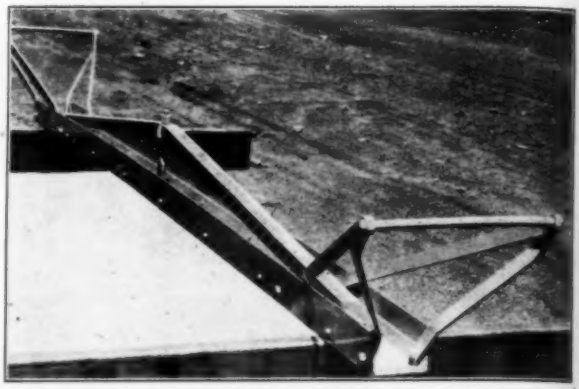
ACCELERATES, HARDENS, FREEZEPROOFS—WATERPROOFS CONCRETE

Shipped in 375 lb. non-returnable drum or easy-to-handle 100 lb. moisture-proof bags from 50 convenient distribution points. Our new booklet No. 2001 "Concrete Summer and Winter" sent free on request.

SEMET-SOLVAY COMPANY **Syracuse, N. Y.**

A Hand Strike-off and an Automatic Strike-off

A NEW hand strike-off for concrete road work, consisting of a channel of proper width and thickness crowned to conform to specifications, has recently been developed and placed on the market by the Heltzel Steel Form & Iron Company, Warren, Ohio. An adjustable truss is provided and securely fastened to and parallel with the channel. This truss is so arranged that the crown of the strike-off may be either increased or decreased as desired, above or below the neutral crown, as specified. This marks an advance over the usual strike-off, which does not retain its true crown for any material length of time. Suitable handles are provided for the operators, who can use the machine for tamping purposes as well as striking off.



A HAND STRIKE-OFF FOR CONCRETE PAVING, MADE TO INSURE CONSTANT CROWN, ONCE SET TO THE DESIRED HEIGHT

The Automatic Strike-off

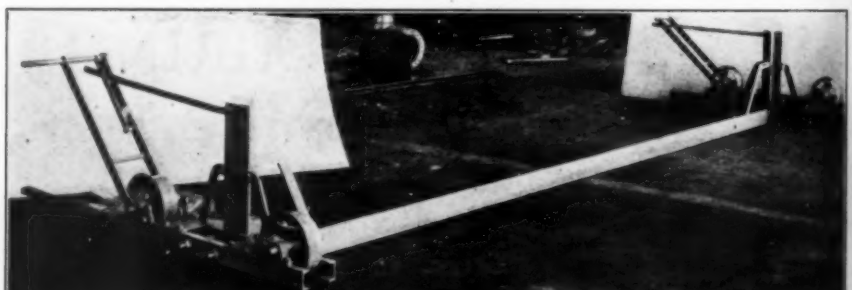
A so-called "automatic" strike-off and subgrader has also been developed by the Heltzel Steel Form & Iron Company. These machines are called "automatic," for by pressing slightly on the lever the strike-off proper rises to sufficient height to clear the subgrade or material struck off or graded while the machine is being reversed. The machine may be run on each side of the road, on forms, curb or gutter as required. The 12-inch wheels which are used when the machine is used on the curb or gutter may be reversed so that the flange will operate on the inside.

The machine weighs about 1,000 pounds, and yet is more easily operated than a 200-pound hand strike-off. It is said that the machine will also do grading and subgrading equally well. The cross member is crowned to specifications, and the grader blades are attached to an arc conforming to this crown.

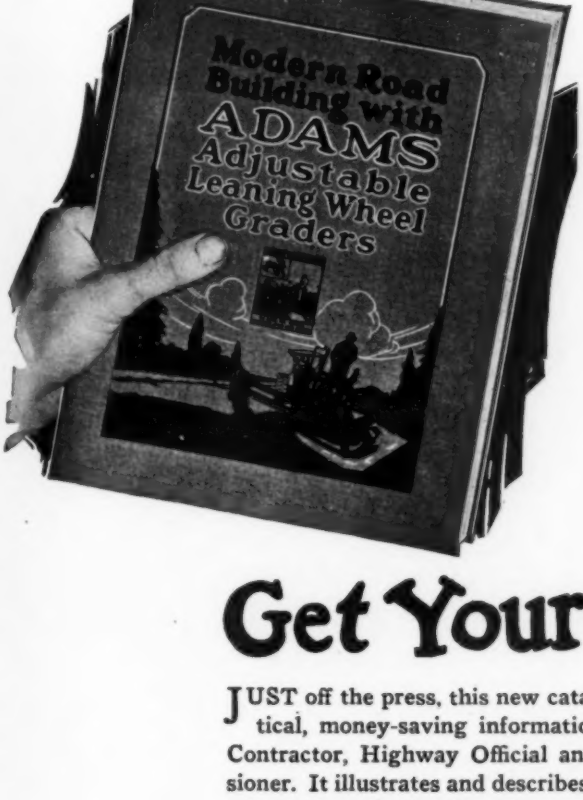
The principle embodied in this machine utilizes the momentum and weight of the machine in striking blows. In reversing and pushing forward a heavy blow is struck against the material either when subgrading or when striking off such material as sand, concrete or slag.

Ordinarily, contractors can use a tractor, roller or truck in drawing the machine forward when it is used for heavy work. It often happens, however, that this motive power is in use elsewhere, and when such is the case the machine can always be used by hand power.

The strike-off or grading cross member can be raised and locked instantly in any position. This member, however, is always set permanently in the heads at any point from the top of the forms to as much as 10 inches below, if required.



AN AUTOMATIC STRIKE-OFF WITH MANY DESIRABLE FEATURES



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JUST off the press, this new catalog is full of practical, money-saving information for every Road Contractor, Highway Official and Street Commissioner. It illustrates and describes in detail the most advanced methods of road construction—tells how you can build better roads at much less cost by using Adams Leaning Wheel Graders—and shows the complete line of Adams Road Machinery.

If you purchase or influence the purchase of road machinery, we shall be glad to send you a copy of this new book. Use the coupon below.

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C. E. M. 2-24.

Manufacturers ---- Distributors ---- Consumers

Published under the auspices of the Associated Equipment Distributors, Sixteenth Street Viaduct, Milwaukee, Wisconsin

Manufacturing and Distributing

By C. R. Messinger

President, Chain Belt Company

MANUFACTURING offers two fundamental problems: first to make an article for which there is a demand; and, second, to put this article into the hands of the consumer. Considering our own product, we feel that these two problems are of equal importance and that we have certain well-defined obligations to the contractor as to both our manufacturing and our selling policy. Our first problem is to design and build from a performance standpoint, meeting the conditions as our customer finds them in the field, and enabling him to get his yardage at the lowest possible cost. Thirty years of manufacturing experience has taught us that the selling price of our product must be somewhat competitive, but that we have erred whenever we have designed or built to meet a competitive selling price. Contracting is even more highly competitive than our own business, and a manufacturer must never lose sight of the fact that the ultimate test of contractors' equipment is the final cost of the work done.

We believe that our most successful procedure is to first produce and design a machine which is workable and rugged and embodies the most advanced ideas, even though the machine appears to have a higher cost than similar equipment on the market. It is our problem then to bring modern shop methods and quantity production into play to reduce our own cost and bring the selling price of the machine within reach of our customers.

Our second obligation, as important as the first, is the choice of a method to distribute or sell our product. It is often contended that direct selling is the logical method for large equipment. This in brief would mean the maintenance of our own sales offices and repair stocks in important centers throughout the country and through these offices dealing directly with the consumers. This method has many advantages to a manufacturer making allied lines of equipment, but we are not interested in developing allied lines for the contractor trade. We are, however, very much interested in specializing on pavers and mixers, as concentration of effort enables us to design and build more efficiently, obtain quantity production, and give more per dollar to the ultimate consumer.

Compared with automobiles, farm implements and similar products, the number of concrete mixers and pavers bought in a year is relatively small, and we feel that to maintain our own warehouses would increase the cost to the user. Our problem then is how to sell intensively. We believe that there is no better method of distribution for mixers and pavers than through reliable contractors' supply houses or so-called distributors. Our conception of a reliable distributor is an organization handling reliable lines with an investment in stock and a large enough organization to cover the territory intensively. A distributor's organization cannot economically confine itself to any one article of construction equipment, but such an organization, if it does not handle too many lines and confines itself to allied equipment, will sell so large a volume that the final selling cost is unusually low. We believe that through this method of distribution we can put the product into the consumers' hands at a lower price than by attempting to give equal service in the direct handling of our product alone.

The wide-awake distributor handling major allied lines becomes a specialist in his field. He is familiar with the performance of the various types of equipment, and his organization is schooled to give service. He is in close touch with the contractor at all times, and this personal contact is something that is valuable both to the contractor and to the manufacturer. We do not view the distributor as a middleman, or consider that his compensation is an additional tax to the product. The contractor actually saves money by dealing with the distributor because he gets the benefit of service that would be impossible but for the fact that the distributor's expense is spread over a large volume.

The manufacturer, the contractor and the distributor are all dependent upon each other, and all are equally important. We wonder if the contractor realizes just what part the distributor plays in delivering a product such as ours, and also whether he distinguishes between the reliable distributor and the agent. The reliable distributor is endeavoring to build permanent good-will in his own territory and is spending money to do it. This alone is a guarantee that both the consumer and the manufacturer will receive worth-while service, as the average distributor knows that it is the foundation on which he must build his business.

Users of the New One Man Method of Concrete Curing Say:

1. ***Dowflake,*** "eliminates the continual trouble between inspectors and contractors over the covering of the pavement. It can also be handled by two men in place of 8 or 10, which is very valuable in times when labor is scarce."

2. "It not only saves labor but makes a much better pavement."

3. "In building thirty and one-half miles we made daily runs of from 1000 to 2000 feet and each day's run was cured the next morning by 10 o'clock with ***Dowflake.*** You always get a smile from the engineer in charge when this is done. Two laborers, three hours per day, is all that is necessary to cure 2000 feet of 18 foot slab."

4. "Find it much more satisfactory than by using dirt, as we only had to have one man to put it on. It is also more satisfactory to the engineers than the dirt, for once it is put on they don't have the trouble of seeing the pavement is taken care of by putting water on for the next ten days as when you use the dirt."

5. "Our superintendent reports that this has not only enabled him to work faster but has very considerably cut down his operating costs."

6. "Another very redeemable feature—is that the contractor does not have to maintain a long pipe line behind the paver—will be users as long as we are in the highway construction business."

7. "No contractor can afford to use pond or earth when your material is available."

A mass of other letters from users of ***Dowflake*** repeat and affirm that earth ponding, straw coverings, etc., are obsolete and costly methods—that ***Dowflake*** cures concrete easier, quicker and better—is an economy and a protection for both contractor and taxpayer.

Write for our new book "How to Cure Concrete."

THE DOW CHEMICAL COMPANY

261 JEFFERSON AVE. MIDLAND, MICHIGAN

BRANCH SALES OFFICES:

90 West Street, New York City — North Second & Madison Sts., St. Louis, Mo.

KEEP ROADS UP AND TAXES DOWN WITH

DOWFLAKE

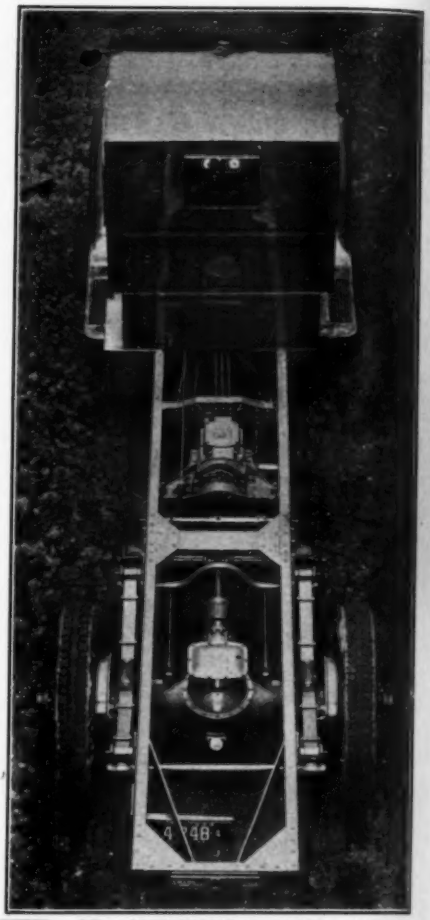
CALCIUM CHLORIDE

A New 2½-Ton Commercial Truck

THE American-LaFrance Fire Engine Company, Inc., Elmira, N. Y., in December, 1922, began the construction of commercial trucks at its new commercial truck factory in Bloomfield, N. J. In describing this new line of commercial trucks, the American-LaFrance interests state that the trucks depend more upon quality of material, design and workmanship for their serviceability and performance than on any particularly noticeable features. Nevertheless, there are certain outstanding examples of engineering progress claimed not to be found to a like degree in other commercial vehicles. Several of these are patented and are exclusively used in American-LaFrance trucks. These include: (1) dry plate clutch with patented self-aligning pressure plate; (2) simplified governor with micrometer adjustment; (3) chrome nickel steel crank-shaft; (4) oil sediment partition; (5) wick lubricated front axle pins; (6) disc type air impeller cooled transmission brake; (7) plastic nickel bronze universal joint, radius and torque rod end bushings; and (8) adjustable brake and clutch lever pads.

Particular attention has been given to securing ease of maintenance and accessibility for repairs. The engine assembly complete with clutch, accelerator pedal rods, levers, etc., can be removed readily as a unit from the chassis. The transmission is so designed that the shifting forks, interlocks and sliding shafts are integral with the gear case cover and hence can be removed as a unit. The service and emergency brakes may be adjusted quickly for wear. These and many other details of design have been worked out expressly for the satisfaction and benefit of the truck user so that less time will be required for maintenance and overhaul.

The 2½-ton model is supplied in three wheel-base lengths thus permitting the correct adaptation of bodies to suit any particular haulage requirements.



VIEW OF AMERICAN-LAFRANCE 2½-TON TRUCK TAKEN FROM ABOVE

Progress of Construction on The Bear Mountain Bridge

FOR the particularly interesting front cover which it is our privilege to reproduce in this issue of CONTRACTORS' & ENGINEERS' MONTHLY, we are indebted to the Graphic Section of the *New York Evening Post*, which first made use of this photograph by Art Miller, official photographer for the Palisades Interstate Park Commission. Major William A. Welch, General Manager of the Commission, was responsible for the taking of this photograph showing the initial steel work on the Bear Mountain-Hudson River Bridge, which is the only highway bridge across the Hudson River, and is south of Albany, a distance of 144 miles.

The bridge was designed by Howard C. Baird, of Hodge & Baird, who is acting as consulting engineer for the Bridge Company. Professor William H. Burr and Major William A. Welch are also on the company's consulting staff, and Wilson Fitch Smith is Chief Engineer for the Bear Mountain-Hudson River Bridge Company. The general contractors are the Terry & Tench Company, Inc., well-known structural erectors and bridge builders. McClintic-Marshall Company of Pittsburgh, Pa., is fabricating the steel, and the John A. Roebling's Sons Company of New York is manufacturing the cable wire and suspender ropes.

The bridge is being built with private capital by the Bear Mountain Hudson River Bridge Company, of New York City, under a charter granted by the New York Legislature. It is expected that the bridge will be completed ready for traffic before the end of 1924.

KEYSTONE SHOVEL

A Shovel with a Punch

TRADE MARK
KEYSTONE
REGISTERED U. S. PATENT OFFICE

The Keystone can be equipped with three different, readily interchangeable buckets, Skimmer, Ditcher and Clamshell, for varied uses. With each one it has all the efficiency of highly specialized design. A catalog and booklet, "Keystone Shovel Jobs," on request.

THE MODEL 4 FRONT-CRAWLER KEYSTONE is a first-class Road Shovel, with heavy ⅝ yard Skimmer bucket, weighing sixteen tons. The boiler is 40 x 86 inches vertical fire-tube or cross-tubular type, as desired; and the engine is a double 6 x 6 inch horizontal steam power unit which develops 42 h.p. on a brake test. These machines have PUNCH! They have also exceptional tractionability and versatility, being usable with three different buckets—Skimmer, Ditcher and Clamshell. The boom is 18 feet long, giving a horizontal crowd of 14 feet. That spells success in street grading.

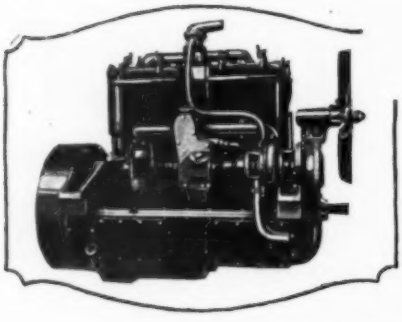
The price is low.

KEYSTONE DRILLER CO., Beaver Falls, Pa.

8-D-21

170 Broadway, New York Monadnock Block, Chicago Joplin, Mo.

KEYSTONE PRODUCTS

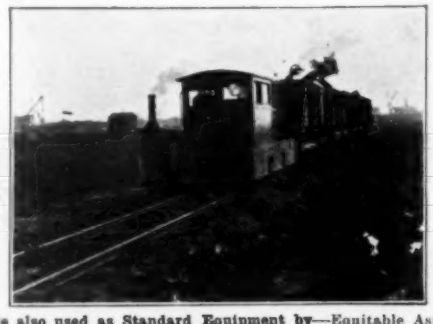


Have You Noticed This Lately?

—That when a Manufacturer brings out a new model or wants to improve the power of any machine already in his line it is now quite the usual thing to equip with

CLIMAX

"The Trustworthy Engine"



Whitcomb 12-ton Gasoline Locomotive, equipped with 6 cylinder Climax Engine, operated by W. J. Newman Co., Chicago, on heavy excavating work. Machine handles 7 to 10 cars, weighing 15 tons each.

The news of the unusually trustworthy performance, fuel economy, and low-upkeep cost of Climax Engines, has traveled fast and far in the few years it has taken Climax to climb to the top. To say any machine is Climax-equipped adds very definitely to its long life and resale value.

Write for Catalog

CLIMAX ENGINEERING CO.
1 West 18th Ave., Clinton, Iowa

Climax Engines are also used as Standard Equipment by—Equitable Asphalt Maintenance Co., Kansas City, Mo.; Bay City Dredge Works, Bay City, Mich.; Byers Machine Co., Ravenna, Ohio; Victor R. Browning, Cleveland, Ohio; Link Belt Co., Chicago, Ill.; McMyler-Interstate Co., Cleveland, Ohio; Northwest Engineering Co., Green Bay, Wis.; Orton & Steinbrenner Co., Huntington, Ind.; The Parsons Co., Newton, Iowa., and many others.

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BOSTON

Kingston Pike, a section of the Dixie Highway at Knoxville, Tenn. Kyrock surface modified Telford Base. Constructed 1921.

KYROCK has demonstrated that it is possible to build the highest type asphalt pavements at a reasonable cost. It has made asphalt construction practicable in smaller towns as well as cities, and on isloated highways.

Kyrock is laid *cold*. It is shipped in open top cars. It is not subject to damage or chemical change from exposure to the elements. It may be stored in the open, even for a period of years.

Shovels, rakes and roller are the only equipment needed in Kyrock construction. The material may be handled with machinery like sand, stone or gravel. Kyrock is laid directly on any standard type base, without binder course. It is shoveled into place; raked to proper thickness and grade, and rolled. The pavement may be opened to traffic immediately.

Not only has Kyrock eliminated costly plant and equipment, used in ordinary high type pavements, but it has removed the risk of failure due to human error. There is no mixing—no heating. Kyrock is a pulverized bituminous sand stone, or rock asphalt. It is thoroughly mixed by Nature. Nothing is added to Kyrock at any state of its production.

The finished Kyrock pavement is the same in appearance as the finest sheet asphalt. However, it is superior to the hot mix types, in that it does not crack, roll, or shove. Tests of Kyrock in service thirty-five years show no loss of life.

Kyrock pavements are easily and inexpensively maintained. When necessary to cut the pavement the surface may be restored by adding Kyrock and tamping. Records of Kyrock pavements in Kentucky show the 1922 maintenance was one-half that required on other high, hard surface type laid by the State. This, despite the fact that the average age of Kyrock pavements was much greater.

Kyrock is the rock asphalt produced by the Kentucky Rock Asphalt Company, oldest and largest producers of Kentucky Rock Asphalt. The big secret of Kyrock success is uniformity. The rock asphalt is first tested by core drilling in advance of the working. Quarry faces are sampled and analyzed. Pulverized Kyrock is laboratory tested at the mills and re-checked before being shipped. Kyrock produced by this company comes from the same location and is the same by test, as the rock asphalt used in the Camp Knox road and other famous old heavy traffic highways.

Laid on adequate base and with observance of the ordinary principles of pavement construction, Kyrock always gives maximum results.

Kyrock is being used today in half the states of the Union for new construction surfacing and maintenance. Our engineering department has prepared typical specifications and cross sections for Kyrock construction and reconstruction on all standard bases.

Engineers and officials in charge of road and street construction or maintenance should write for specifications and literature before planning their new work. Ask for brochure C. E. M.

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The Barton Portable Pumper is efficient and reliable.
Adaptable for construction and road work, public works department, fire protection, etc.

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BURCH SPREADER

In its improved form, it is a greater profit maker than ever before, spreading road material from the truck better and at half the cost of hand labor.

Pays for itself in a mile.

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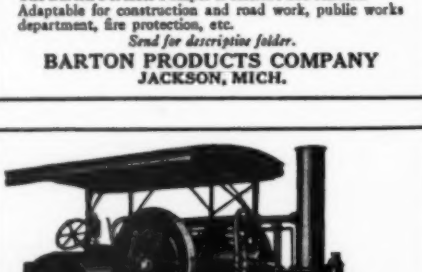

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Furnished with or without Pneumatic Scarifier Attachments

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Concrete Busher for bushing concrete surfaces.

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DANDIE = LIGHT MIXER

EQUIP it to your special needs. Rubber tires to save the time waste of between-job hauls, and to expand your working territory. *Light duty hoist. Low charging platform or power charging skip. Automatic water-measuring tank.* Most important, you can be sure of full capacity—utmost reliability—and long service-life—because this mixer is Koehring built, engineered and constructed to out work, out last anything in the light mixer field. Price? Not the lowest price—no—but the most remarkable value of all light mixers—and still within the range of light mixer prices.

Capacities. 4 and 7 cubic feet mixed concrete, steam or gasoline power. May be equipped with power charging skip or low charging platform with hopper, light duty hoist, automatic water measuring tank. Mixes mortar as well as uniform concrete.

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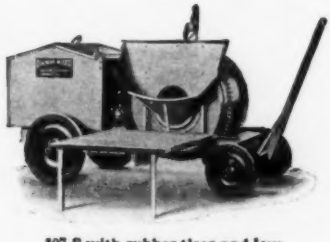
104-S with light duty hoist and power charging skip.

Dandie with steel disc wheels and solid rubber tires; power charging skip, water tank and gasoline engine.



107-S with rubber tires and low charging platform and hopper.

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is a natural combination of flake silica-graphite. The vehicle is pure boiled linseed oil. Dixon's Paint will not crack, peel or flake off. Because of its pigment it gives longer and better protection, making frequent repainting unnecessary. Write for Booklet 148-B.

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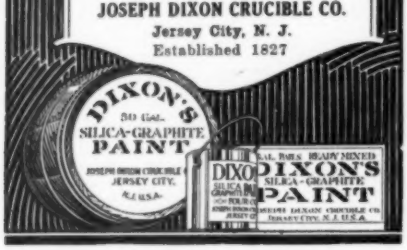
Established 1827



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Stands today a mechanical marvel without an equal. For road maintenance it has many distinctive features—receding platform allowing operator full view of work—long wheel base—large wheels—blade lowered and raised by worm gear. It is easy riding and requires only one man and two horses.

Russell Equipment includes 7 sizes in Road Machines—ranging from the Russell Super-Mogul, weight 9000 lbs., to Russell Gem, weight 650 lbs. Also Scarifiers, Road Drags, Drag and Wheel Scrapers, Drag Lines, Gravel Screening and Loading Outfits, Culverts, Steel Beam Bridges, etc.

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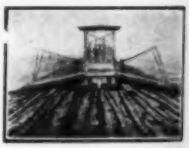

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It has been the experience of thousands of contractors and road officials that the motor-driven type of roller is far superior to the steam type in all around efficiency.

The motor roller is a time-saver. The operator wastes no time fussing with his water and fire. He devotes his entire attention to rolling and more and better work results. This means that the rest of the gang has to work faster to keep up with the roller so money and labor are saved as well as time.

You can share the experience of these thousands of boosters for the Austin Motor Roller. Special Catalog F tells all about it. Drop us a card and we'll send you one by return mail.

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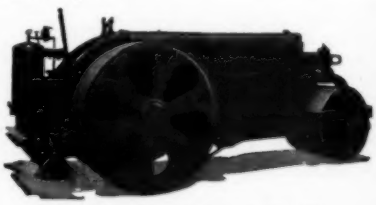
A One Man Maintainer

THE Huber Self-Contained, Power Lift Maintainer is a one-man tool. The long flexible blade reclaims material from outside the track, without destroying the berm or altering the crown. It is most satisfactory for spreading dumps or shaping subgrade.

This self-contained, power Maintainer has weight enough to keep the blade down when making a heavy cut and is powerful enough to pull a detached grader when necessary to cut deep ditches. The heavy duty, four-cylinder engine furnishes excess power.

The Huber Maintainer is economical, fast and dependable. It is equipped with an efficient pressure scarifier. There are none better.



The Huber Road Roller

The Huber Four-Cylinder Gasoline Road Roller combines a modern internal combustion engine with modern power transmission. It starts easy and keeps going. It has a low center of gravity, surplus power, convenient control, and economy of operation. The air controlled scarifier folds up neatly underneath the deck when not in use.

Huber Steam Road Rollers with return flue boilers have been standard equipment with road builders for generations.

Write for illustrated circulars on any Huber Road Tool.

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106 Center Street, Marion, Ohio

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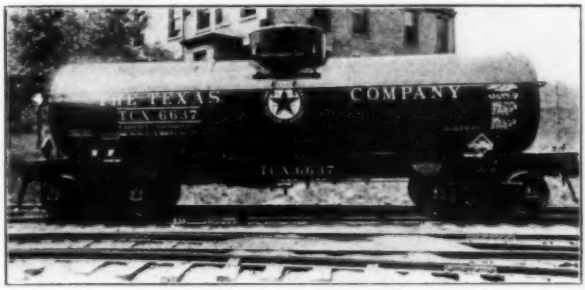

TCX 6637

a TEXACO Thoroughbred

Throughout the year, hundreds of similar thoroughbreds, with the identifying "Red Star Green T" trademark, may be seen on the tracks of railroad systems in all parts of the country, bearing the "makings" of a Good Road to some community.

The great fleet of TEXACO tank cars used in the shipment of TEXACO Paving Asphalts, has been years in reaching its present size, and each year it continues to keep step with the increasing consumption of TEXACO Asphalts.

We realize, above all, that the existing high standard of TEXACO service is one of our strongest assets—*and it will be maintained.*

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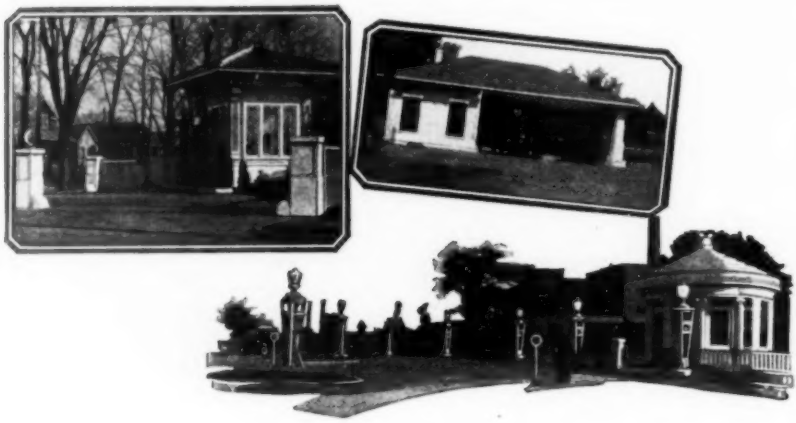


A Real Job for Expansion Joint

THE large areas of concrete usually required around filling stations must have the efficient protection Elastite Expansion Joint provides against expansion.

In drives, curbs, foundations, walls — it saves the job from unsightly cracks, heaving and disintegration.

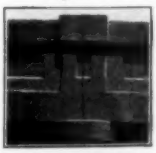
Years of practical experience by engineers and contractors have proved the value of Elastite Expansion Joint in every type of concrete masonry and paving. It is easy and economical to install and effective and durable in service.

Write for complete data, prices and sample. Immediate shipments from ample stocks carried at seventeen convenient distributing centers.

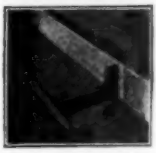
Send your name and address for one of our convenient vest-pocket quantity scales. Tells at a glance correct quantities of cement, sand, gravel and stone required per cubic yard of concrete for any "mix," and lineal feet of Elastite Expansion Joint required per mile of pavement, any spacing and any paving width.

THE PHILIP CAREY CO.
9 Wayne Ave., Lockland, Cincinnati, Ohio

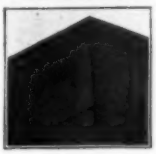
A few other interesting applications



Bridges, viaducts, and concrete retaining walls all require Elastite Expansion Joint at regular intervals to provide necessary easement against expansion.



In curbing, it is particularly convenient, shipped to the job cut to any shape ready to install as shown in the picture.



In concrete roof slabs Elastite Expansion Joint removes danger of buckling and cracking—makes large concrete roof areas of any thickness entirely practical.

Carey Elastite

NAME REG. U.S. Patent Office

PROVED AND ACCEPTED EXPANSION JOINT

Elastite Expansion Joint is an elastic resilient material composed of two sheets of asphalt-saturated felt between which is "sandwiched" a body of carefully refined asphaltic compound.

5-24

EXCESS MACHINERY AND EQUIPMENT AT ATTRACTIVE PRICES

The du Pont Company has available the following machinery and equipment, which is offered for sale at very attractive prices. All of these items are in first-class working condition, and are not "scrap" equipment.

1—200-KW General Electric horizontal turbo generating unit, 600-volt, 240-amperes, 3-phase, 60-cycle, 3600-R.P.M. non-condensing.

1—300-KW Allis-Chalmers Turbo Generating Unit, 600-volt, 362-amperes, 3-phase, 60-cycle, 3600-R.P.M., non-condensing.

1—300-KW General Electric horizontal turbo generator, 2200-volt, 85.2-amperes, 3600-R.P.M.

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1—Orton & Steinbrenner 36-in. or 4 ft. 8½-in., operating weight about 40 tons.

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The Distinguished Service Mark

DISTINGUISHED among contractors and engineers the world over because they know the Waugh sign on a rock drill, drill sharpener, hoist, or compressor outfit signifies mechanical perfection and completely satisfactory performance. Look for it.

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This organization is founded for the purpose of promoting and maintaining a cooperative spirit between the legitimate distributors of construction equipment and their sources of supply; to disseminate information among its members that will assist them in building their business on a broader scale and to exchange ideas of service for the benefit of the actual users of construction equipment.

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Hammer Drills & Tripod Drills

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30 and 36 in. gauge, 23 tons, tractive power 9170 lbs. Coal, oil or wood burners. Very attractive prices.

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THE following cards (arranged by states) show the names of dealers in contractors' equipment and supplies with a record of the various lines handled. Contractors will find this list a convenient means of getting in touch with dealers who make a point of giving satisfactory service and prompt shipments. This directory is constantly consulted by our subscribers and any suggestions regarding it will be welcomed. ⁘ ⁘ ⁘

ALA.

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Blaw Clam Shell Buckets
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Browning Locomotive Cranes
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Elastite Expansion Joints

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301-303 East Markham Street,
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"EVERYTHING for CONCRETE"

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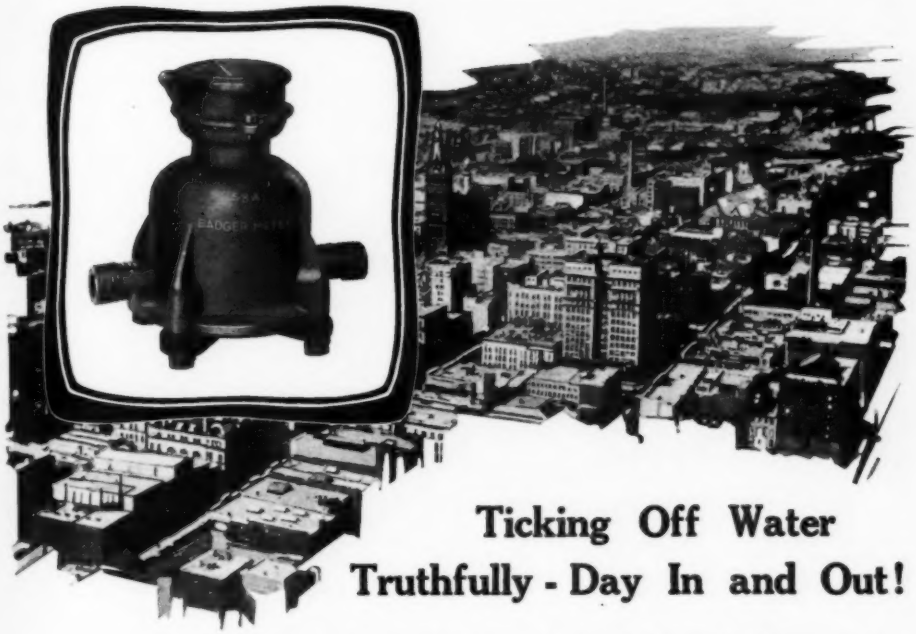

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